The Education of Airbnb's Brian Chesky
BY LEIGH GALLAGHER p. 92

FORTUNE

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INSIDE THE HACK OF THE CENTURY

What Really Happened. Why Sony Should Have Seen It Coming. And Why It Should Terrify Corporate America. BY PETER ELKIND p. 64

SONY

Display Until
July 27, 2015

Can Big Data Help You Get a Good Night's Sleep? p. 102


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FORTUNE

features

Brian Chesky at Airbnb's headquarters in San Francisco

ON THE COVER:
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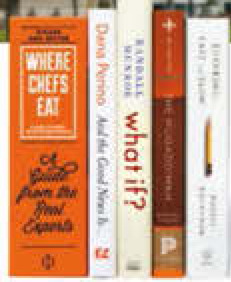
THIS PAGE:
PHOTOGRAPH BY MICHAEL LEWIS

Baseball veteran Todd Zeile

Macro



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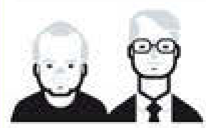
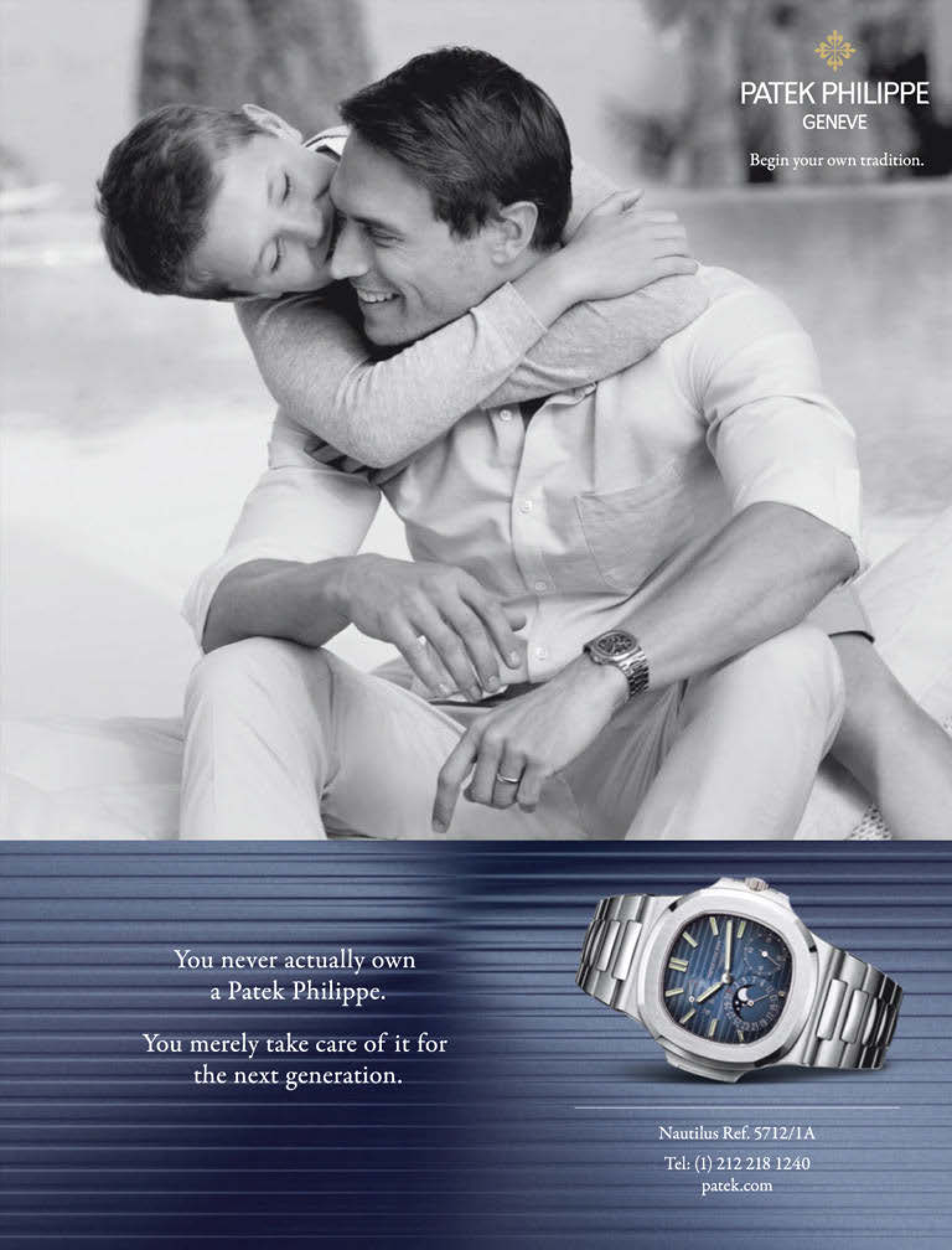


CORRECTION
"An Engine Maker's High-Tech Makeover" (June 15, 2015) incorrectly stated that Nissan would offer a version of the Cummins ISF 2.8 engine in its Frontier pickup. In fact, Nissan used the engine in a concept version of the Frontier in 2014 but has opted not to offer it in production versions.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A Story That Needs Telling

WE HAVE DEVOTED 22 PAGES in this issue to an extraordinary story by Peter Elkind on the now infamous cyberattack against Sony Corp. (see page 64). Time Inc.'s top editor, Norman Pearlstine—who has a longer history with this magazine than I do—says it is "one of the most important stories *Fortune* has ever published." It is also a chillingly compelling, behind-the-scenes narrative of the events leading up to the attack. Were it not about them, the folks at Sony Pictures might make it into a movie.

Editor-at-large Peter Elkind spent six months reporting on the Sony cyberattack.

In his six months of reporting, Elkind interviewed more than 50 current and former Sony executives, cybersecurity experts, and law enforcement officials, and relied on other sources, including emails made public as a result of the attack. We are sympathetic to the violation felt by Sony executives who committed their most candid communications to email, only to see them become fodder for media exploitation. We also are aware of the letter that Sony's outside lawyer, David Boies, sent to us and other news organizations contending that those emails were stolen property and should not be used. And we acknowledge that the rise of the Internet, WikiLeaks, hackers, and the likes of Edward Snowden have dramatically changed the nature of our craft and our relationship with the subjects of our work.

Nevertheless, the story behind the Sony hack needs to be told, and told in full detail. What happened to Sony could happen to others, and the ramifications could be far more severe. The mistakes Sony made—failing to build adequate defenses despite a decade of hacking threats; focusing more intently on the risk of attack from an activist investor than from potential cyber-invaders—are mistakes that are being echoed elsewhere. There are lessons here that need to be learned.

We don't condone the theft of data from Sony, and we played no role in causing or encouraging it. Reporters have long accepted information from unsavory sources. It's our job to make sure that information is accurate, to determine whether it is newsworthy, and to do the reporting necessary to present it in proper context. In this case we have done all that, and believe our decision to publish is not only justified but also necessary.

In our recent survey of *Fortune* 500 CEOs, 10% of respondents called cybersecurity their "single biggest challenge," with another 56% saying it was one of their "top three or four challenges." And yet while companies now recognize the need to protect their computer systems, many still struggle with how to accomplish it. Some are looking for a silver bullet—the ultimate firewall, antivirus software, or "black box" solution—even though experts agree that search is futile. Others say they find it hard to justify spending hundreds of millions of dollars to protect against a risk that no one has been able to quantify and that doesn't appear on their balance sheet.

Whatever rationalizations companies may offer, however, attacks against Sony, Anthem, J.P. Morgan, Target, and most recently the government's Office of Personnel Management should by now have convinced us all that the cyberthreat is an existential one, and it isn't going away. We can't keep the hackers out. What we must do is a better job following the basic hygiene that makes it harder for them to get in—and installing systems and procedures to quickly detect and respond to their incursions. It also may be time to explore alternatives to the open architecture of the Internet for our most sensitive communications.

At the government level, there is one more issue that urgently needs to be addressed: deterrence. In the nuclear era we have avoided conflagration because nations with nuclear weapons know retaliation will be swift and certain. In the cyber age we have yet to develop such policies. What price has North Korea paid—if, indeed, it is responsible—for its attack on Sony? What price will the Chinese pay for the theft of U.S. government files, and many others that preceded it?

Until there are consequences, state-sanctioned cyberattacks will continue to grow.

ALAN MURRAY
Editor
@alansmurray

PHOTOGRAPH BY **VIRGIL BASTOS**

SCOTT STEINBERG

1 Forget Playing It Safe

"Never let failure make you risk-averse. Staying within your safety zone is the quickest way to mediocrity. Truly revolutionary accomplishments can only be achieved by taking big chances."

2 Don't Fear Failure

"Failure means we are taking chances and pushing the envelope as far as it goes. It is a sign that we are striving high enough to ultimately build greatness."

MASTER RISK TAKER

It's hard not to be deterred by disappointments. But leading business strategist and innovation consultant **Scott Steinberg** stresses that obstacles are the cornerstones of opportunity. Here's how to use them to your advantage.

3 Exploit Errors

"We also learn much more from our failures than from our successes. We learn what the market wants and our strengths and weaknesses."

4 Tough It Out

"Greatness is very rarely achieved on the first try. Think of Abe Lincoln repeatedly losing political elections while facing personal tragedy. He refused to give in, and as a result, we're standing in the United States today."

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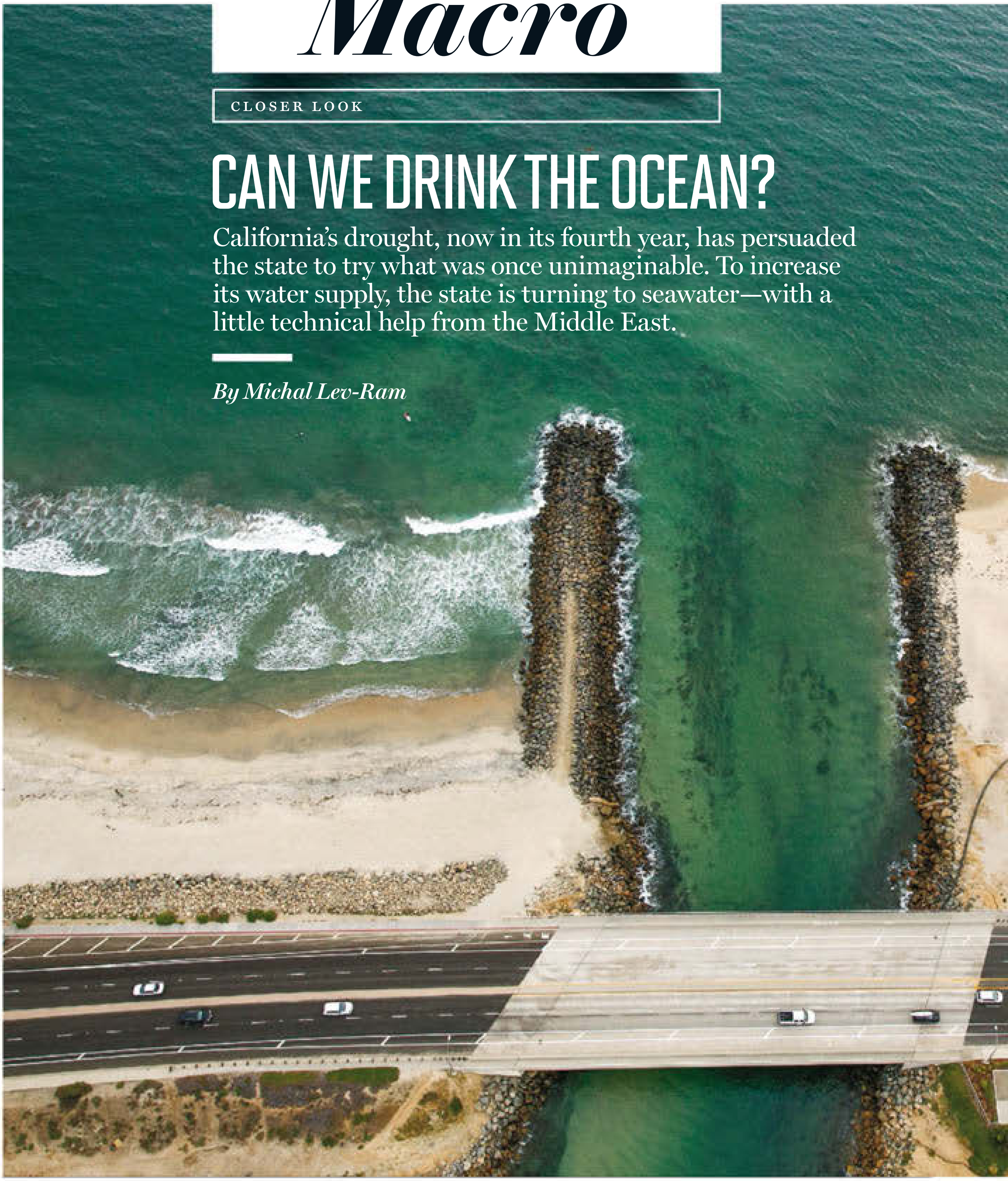
Macro

CLOSER LOOK

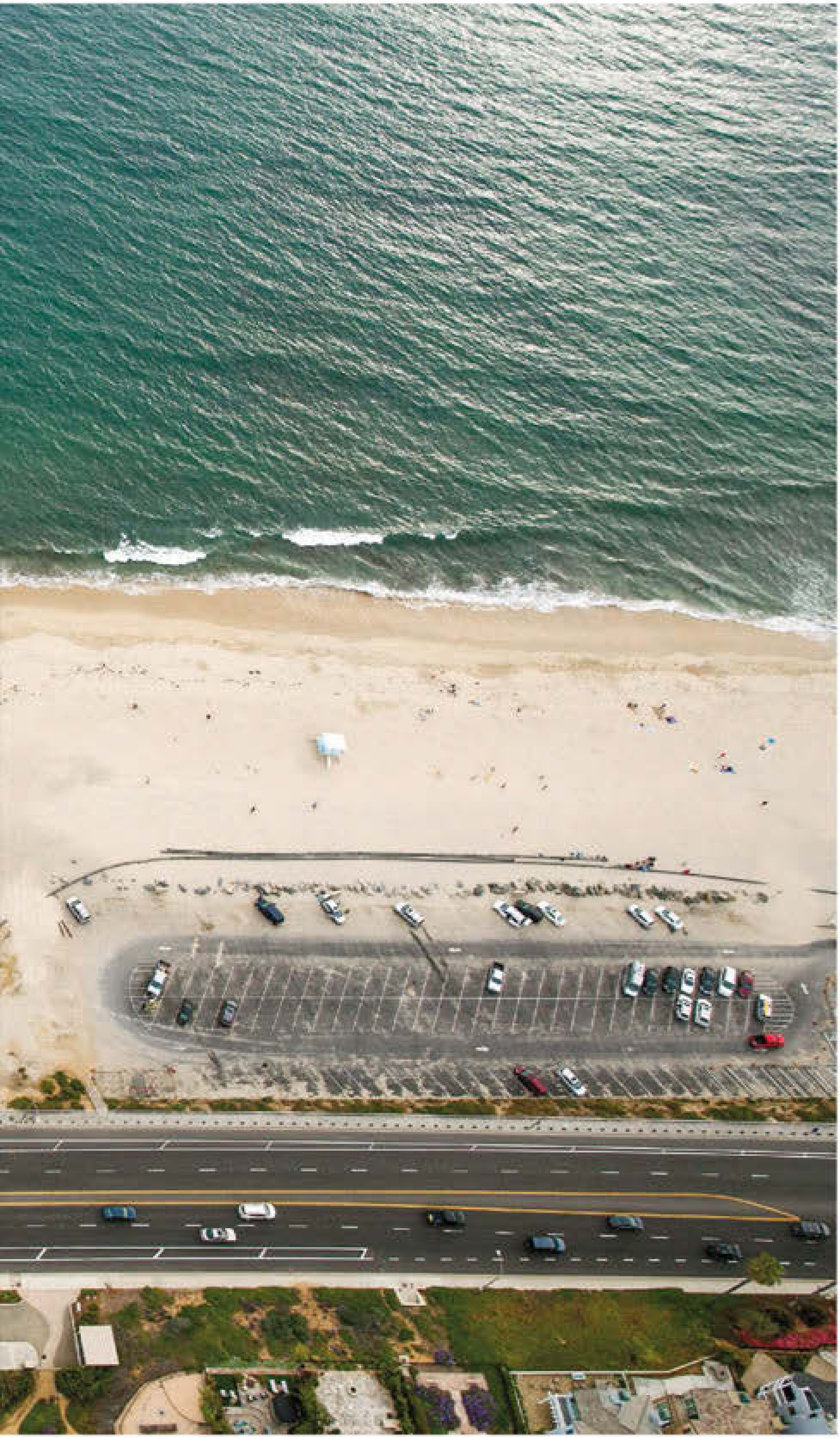
CAN WE DRINK THE OCEAN?

California's drought, now in its fourth year, has persuaded the state to try what was once unimaginable. To increase its water supply, the state is turning to seawater—with a little technical help from the Middle East.

By Michal Lev-Ram



PHOTOGRAPH BY DAMON WINTER—REDUX



ISRAELI PRIME MINISTER David Ben-Gurion, in a speech some 60 years ago, implored his nation's scientists to find a cheap way to turn the Mediterranean into potable water. Today that small, rain-deprived country gets more than one-quarter of its H_2O supply from treated salt water.

California, now in its fourth year of a devastating drought, may follow a similar trajectory. In April, Gov. Jerry Brown made a Ben-Gurion-like plea, ordering state agencies to accelerate the use of cutting-edge technologies to bolster the water supply. That call turned into a tacit blessing for efforts like the Carlsbad Desalination Project, just north of San Diego, the largest desalination facility in the Western Hemisphere. The plant has been in the works for nearly two decades, with construction costs of $1 billion so far. After years of permit purgatory and lawsuits, it will finally go live this fall. By 2020 it is expected to provide upwards of 50 million gallons of freshwater daily, meeting about 10% of San Diego County's water demand.

The site's impact and cost will be closely watched. The drought has wreaked havoc on the state's enormous agriculture industry. It's expected to cost the state's economy $2.7 billion this year alone, and it's contributing to rising food prices nationwide. And the Golden State has 800 miles of coastline—abutting a seemingly endless supply of potentially potable water.

Still, less than 1% of California's water supply comes from the ocean, and moving that needle higher may prove challenging. Desalination involves pumping seawater through high-pressure tubes and polymer-made membranes in order to separate the dissolved salt ions—a procedure

A seawater intake point for the Carlsbad desalination plant, which will eventually produce 50 million gallons a day of freshwater.

that is both costly and energy intensive. It also leaves behind a concentrated brine that is pumped back into the ocean—another process whose ecological impact worries conservationists.

Necessity, however, is the mother of invention, and it sometimes trumps environmental anxiety. That's how the world's largest desalination plant came to be located in Israel, 60% of which is covered by desert. About 10 miles south of Tel Aviv is the Sorek plant, which went live in 2013. It was built by Israel Desalination Enterprises, an engineering firm that is providing some of the Carlsbad plant in partnership with Poseidon Water, the Boston-based company spearheading the privately funded project. Other Israeli developers of water-conserving technologies are also vying for contracts in California.

Saudi Arabia, India, and Australia now have working desalination plants. Texas, Florida, and other states are considering expanding their use of the technology. But desalination is just one aspect of addressing water scarcity, and the high cost and relatively modest production of the Carlsbad plant suggest its limits. And Israel, it's worth remembering, has an advantage over California: For security reasons, its water system (including its vast aquifers) is run by a single, central government planning body. That's something California—whose water supply is spoken for by thousands of disparate public agencies and private owners—will have a hard time emulating. Desalination is, at most, "a security blanket," says Seth Siegel, a water-policy activist and author of the book *Let There Be Water*, to be published in September. "There is no silver bullet."

WATER AND CASH FLOW

Drought conditions and water shortages in California and elsewhere are generating opportunities for a diverse range of businesses.

POSEIDON WATER

This developer, based in Boston, specializes in bringing together public agencies, investors, and contractors on water supply. Current projects include desalination plants in California, Texas, and Mexico.

GENERAL ELECTRIC

GE's huge Power & Water division sells filters and equipment that reduce water waste. It also makes "seawater membranes" and filters that are key components of desalination projects.

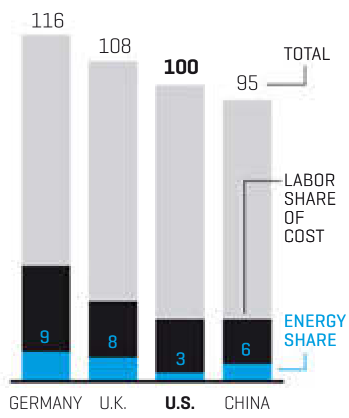
DELOITTE

When water is scarce, many industries struggle to sustain their supply chains. Consultant Deloitte has carved out a niche for itself counseling big companies on water-resource management.

FRUITION SCIENCES

Could big data help drought-stricken farmers use water more wisely? Many startups think so. Fruition, in Oakland, uses a sensor system to help grape growers more efficiently distribute water at their vineyards.

MANUFACTURING COST INDEX



ENERGY MATH

CLOSING A FACTORY GAP, THANKS TO FRACKING

Just how good has the fracking boom been for U.S. manufacturers? Very good, according to the Boston-based consultancy BCG. Thanks to the newfound abundance of domestic oil and natural gas, factories' energy costs have plummeted; U.S. industrial electricity prices are now 30% to 50% lower than those of other major exporters. As a result, by BCG's calculations the average cost of manufacturing in the U.S. is now only 5% higher than in China.

With that gap so narrow, manufacturers have much less incentive to move production to China, notes BCG's David Gee. Harvard Business School professor Michael Porter says America has a 15-year lead on other nations in fracking, which means its edge may grow. Indeed, BCG sees U.S. manufacturing costs dropping below China's by 2018. —*Brian Dumaine*

BUILT FOR SPEED

154 MPH THE AVERAGE SPEED OF THE WINNING CAR, A MODIFIED PORSCHE 919, IN THIS YEAR'S 24 HOURS OF LE MANS GRAND PRIX. MAINSTREAM AUTOMAKERS SEE THE FAMED FRENCH ENDURANCE RACE AS AN OPPORTUNITY TO TEST TECHNOLOGIES FOR THEIR PRODUCTION CARS—AND TO MARKET THEMSELVES TO THRILL-SEEKING DRIVERS. (AUDI, NISSAN, TOYOTA, AND CHEVROLET ALSO FIELDED CARS AT LE MANS EVENTS THIS YEAR.)

JASON HARPER RACED AN ASTON MARTIN AT LE MANS; READ HIS ACCOUNT AT FORTUNE.COM.

GRAPHIC SOURCE: BOSTON CONSULTING GROUP; CAR: MAX EAREY—COURTESY OF ASTON MARTIN

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SOFT ON CRIME

CREDIT CARD HACKED? YOUR BANK MAY SHRUG

CREDIT AND DEBIT CARD FRAUD cost the U.S. $6.15 billion last year, according to *The Nilson Report* industry newsletter. So you'd think the financial services industry, which shoulders most of the cost, would be proactive about quashing the use of stolen card data. But it may not make financial sense for your bank to replace your card—even if it knows the card has been compromised.

In card data thefts, cyberattackers typically steal the data—say, by hacking a retailer—and then auction it to fraudsters on online black markets. If your info is up for sale on a baleful bazaar, your bank may know it, because security firms trawl the "carder" underworld to compile lists of stolen data that they then sell to banks. But from there, "fraud is a numbers game," says Ricardo Villadiego, CEO of one such firm, Easy Solutions of Sunrise, Fla. Since each reissued card costs the bank about $5 to process, the expense of retiring a card may not be worth incurring until somebody starts misusing it.

Banks and payment companies *Fortune* spoke to—including Chase, American Express, and PayPal—declined to comment about whether they use carder research services. But Avivah Litan, vice president at Gartner Research, says bigger banks often find it more cost-effective to keep watch lists—and to act only if things get ugly for them, and you. —*Robert Hackett*

TROUBLE ON THE FARM

'Big Ag' Is Laid Low by a Virus

Huge "layer operations," designed to protect hens from disease, were vulnerable to a fatal flu.

WE HAVE SEEN THE FUTURE, and it's northwest Iowa. This spring this corner of the Hawkeye State has been overwhelmed with dead birds—31.5 million of them. For weeks flu-stricken and euthanized chickens, turkeys, and other fowl piled up in dumpsters, attracting flies and emitting a stench. Only recently has the disposal crisis abated, with the help of round-the-clock incinerators and crews in hazmat suits.

The carnage is the work of H5N2, the virus whose sweep through Midwestern poultry farms (Minnesota has been badly affected too) had killed 48.1 million birds as of late June. It's the worst avian flu outbreak in U.S. history, and its impact is spreading: Egg prices have soared, and food companies, including Hormel and Post Holdings, have warned of likely declines in sales. The cost of dead poultry stands at $191 million; the total economic damage of the outbreak, in Iowa alone, is estimated at $957 million.

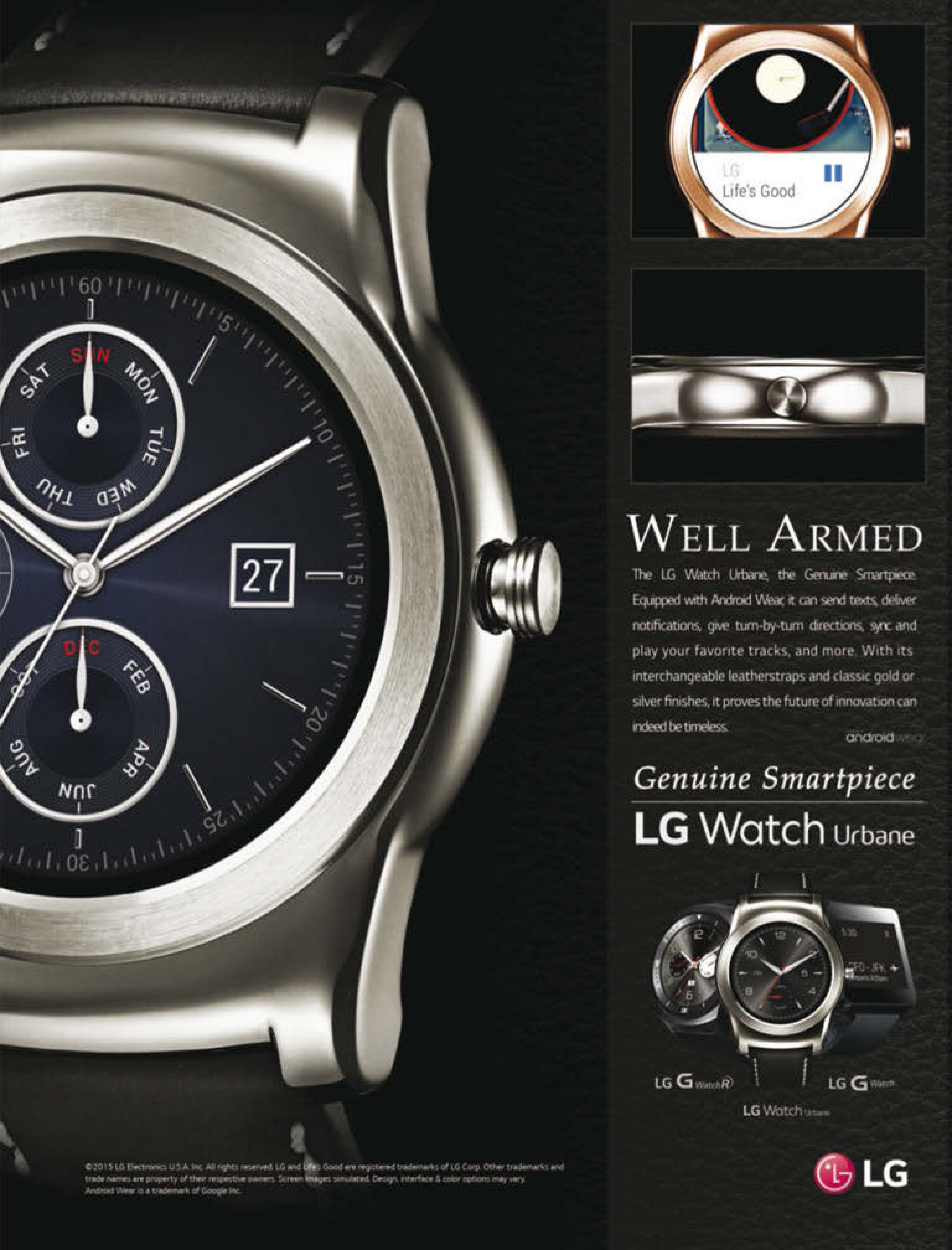
48.1 MILLION
CHICKENS, TURKEYS, AND OTHER BIRDS KILLED IN THE H5N2 OUTBREAK

80%
INCREASE IN EGG PRICES SINCE JANUARY 2015

But perhaps the most troubling aspect of the crisis is its implications for the viability of industrial-scale farming. The egg industry's huge "layer operations"—the sort that house millions of birds in one place—are designed to *protect* birds from contamination. The animals' environment is tightly controlled, and workers who enter the henhouse follow special hygiene protocols. But when a virus pierces such defenses, or when defenses lapse, having all of one's eggs in one basket (so to speak) can make the impact more devastating.

The poultry apocalypse also exposes the food system's vulnerability to highly contagious diseases. Like previous avian strains, H5N2 arrived in the U.S. in the droppings of migratory birds, says Jim Roth, director of the Center for Food Security and Public Health at Iowa State University. But it seems to have spread among farms in the Midwest in novel, unforeseen ways. The role of wind and even ventilation systems—transmission routes that current biosecurity strategies don't address—are now the subject of intense study and anxiety. "Everything was working great for the diseases we knew," says Roth, "but avian influenza is changing the rules." —*Erika Fry*

RYAN DONNELL; ILLUSTRATION BY MARTIN LAKSMAN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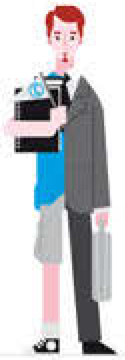
THE SUMMER-JOB MARKET

THE INTERN ECONOMY BOUNCES BACK



THE FULL-TIME GROWNUP job market isn't the only one on the rebound: According to employment research firm Burning Glass, internship openings for college students have fully recovered to pre-recession levels. The number of positions available for the summer grew 3% this year over last, to a total of 118,421 postings (a growth rate roughly in step with that for entry-level jobs).

More important, many experts think the quality is rising along with the quantity, as more companies shed fetch-the-VP's-coffee-for-no-pay internships in favor of programs that are key to their talent pipelines. "Internships have become the approach du jour to bringing new people in," says John Challenger, CEO of the outplacement firm Challenger Gray & Christmas. Burning Glass data suggest that's particularly true for employers in the arts, and in video and graphic design.

The more desirable the internship, of course, the stiffer the competition. For many positions in the technology arena, students need to know programming languages like Java or SQL even to be considered, says Burning Glass CEO Matt Sigelman. In communications and marketing—the largest internship segment—candidates will get nowhere if they can't demonstrate their social media chops. But as the bar for entry gets higher, some experts are optimistic that unpaid internships are going out of style. If that proves to be true, lifeguarding and waiting tables may soon become even less appealing to ambitious college kids. —*Claire Groden*

MOVIE DÉJÀ VU

THE REBOOT: *The Sequel's New Shape*

DINOSAURS DIDN'T STAND the test of time, but that didn't stop tinkerers from reincarnating their genetically modified brethren, hoping to reap enormous wealth. That's the premise of the Jurassic Park movies, of course, but it's also a metaphor for what Comcast-owned Universal Pictures just did with its dino-franchise.

Jurassic World is a "reboot"—a film with the same conceptual DNA as earlier movies in the series but with little continuity of plot or character to bog down the action. A reboot can make a stale franchise feel fresh, or revive one that some viewers are too young to remember. It certainly paid off for Universal: While each of the previous Jurassic movies was less popular than the one before it, *Jurassic World* had the biggest opening weekend in history, earning $524 million worldwide in just three days.

Hollywood long ago figured out that sequels boost its odds of success. "Audiences decry the lack of inventiveness," says Paul Dergarabedian, an analyst with box-office research firm Rentrak. "But these franchises are the top movies of the year." Still, this summer could offer some clues to whether audiences prefer the reboot approach to the traditional sequel. Two true sequels (*Ted 2* and *Mission: Impossible—Rogue Nation*) and a major reboot, *Terminator Genisys*, open in July. Another summer reboot, *Mad Max: Fury Road*, is among the year's top 10 grossers so far. And December will bring a highly anticipated sequel, when Lucasfilm's *Star Wars: The Force Awakens* visits a galaxy far, far away—all over again. —*Michal Lev-Ram*

Sequels and reboots of 2015 (from left to right): *Star Wars: The Force Awakens; Jurassic World; Ted 2; Mad Max: Fury Road; Pitch Perfect 2; Mission: Impossible—Rogue Nation; Terminator Genisys;* and *Furious 7.*

ILLUSTRATION BY MARTIN LAKSMAN; FURIOUS 7, JURASSIC PARK, PITCH PERFECT AND TED: UNIVERSAL PICTURES/PHOTOFEST; MISSION IMPOSSIBLE: PARAMOUNT PICTURES/PHOTOFEST; TERMINATOR: PARAMOUNT PICTURES/IMDB; STAR WARS: DISNEY/IMDB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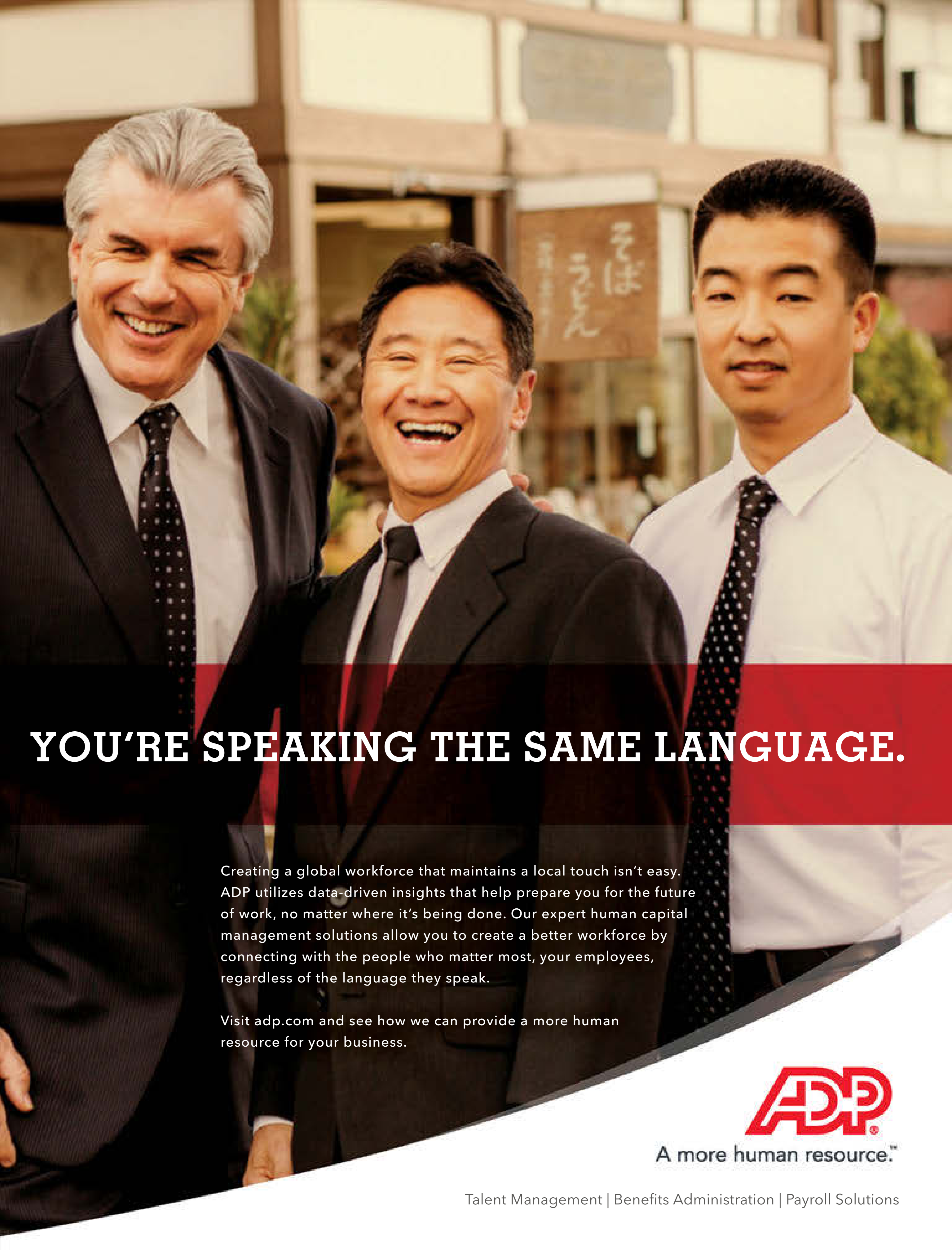
THERE'S A LAUGH, AND YOU REALIZE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EXECUTIVE READ

A Summer Break From Business Books

WHAT THE CORNER-OFFICE CROWD IS READING AT THE BEACH.

By Anne VanderMey

Summer vacation, in theory, is a time to take a break from thinking about the office. In practice, it's a time when many executives broaden their horizons beyond the office—the better to crush the competition when they go *back* to the office. In that spirit, here are five nonbusiness picks from five business-world leaders.

MANFRED KOH PHOTOGRAPHY

WHERE CHEFS EAT: A GUIDE TO CHEFS' FAVORITE RESTAURANTS

By Joe Warwick

Mary Erdoes, CEO, J.P. Morgan Asset Management

Every summer Erdoes's team sends reading picks to J.P. Morgan's wealthy clients. The list originally focused on finance, but these days it also includes titles about where to spend your money. Among this year's choices: the 2015 edition of this dining guide, which compiles tips from chefs and restaurateurs about their favorite eateries in cities from Chicago (molecular-gastronomy hub Alinea) to Cape Town (locavore favorite Superette).

AND THE GOOD NEWS IS ...: LESSONS AND ADVICE FROM THE BRIGHT SIDE

By Dana Perino

Karl Rove, political strategist

In 2008, Rove held a contest with then-President George W. Bush to see who could read the most books over the course of the year. (Rove won, but not by much.) Today the GOP operative's Twitter feed is packed with book picks. This summer he points to the new memoir from Perino, Bush's former press secretary. "Dana offers invaluable life and work advice," Rove tells *Fortune*. (Perino also writes that Rove, her White House colleague, was "so nice and approachable.")

WHAT IF?: SERIOUS SCIENTIFIC ANSWERS TO ABSURD HYPOTHETICAL QUESTIONS

By Randall Munroe

Bill Gates, philanthropist

Gates, who's often a book-a-day reader when on vacation, is recommending lighter fare this summer. This illustrated 2014 tome by the author of the web comic "xkcd" ponders such far-out scientific questions as, "What would happen if you made a periodic table out of cube-shaped bricks, where each brick was made of the corresponding element?" Answer: The human race would essentially be wiped out. It's funnier than it sounds.

THE MUQADDIMAH: AN INTRODUCTION TO HISTORY

By Ibn Khaldûn

Mark Zuckerberg, CEO, Facebook

Last New Year, Zuckerberg announced his intention to read an important book every other week in 2015. So far the 31-year-old exec's picks have focused on history and sociology. This summer selection was written by an Arab historian in 1377 (and reissued this year). One scholar called the book, one of the earliest critical studies of history, "the greatest work of its kind that has ever yet been created by any mind." In other words, beach reading.

THINKING, FAST AND SLOW

By Daniel Kahneman

Beth Comstock, president and CEO, GE Business Innovations, and CMO, GE

This summer Comstock plans to read Kahneman's bestseller about human reasoning, which delves into the ways our unconscious can affect even "rational" thinking. Comstock tells *Fortune* that she's a "student of human behaviors and motivation" (as befits a marketing executive). She also says she's a "big fan of Kahneman's work," and in that she's hardly alone: The psychologist and Nobel Prize winner also counts other CEOs and President Obama among his readers.

haveKINDLEwillTRAVEL
@KDKUIPER, BANGKOK | Amazon asked if I'd bring the Kindle Paperwhite on my trip to Thailand. After wandering the crowded streets of Bangkok, I found my way to the floating market on the Chao Phraya river and got lost in the Sonchai Jitpleecheep series.
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Zeile, an L.A. native, underneath the Balboa Pier in Newport Beach, Calif.

PRO-FILES

A FORMER SLUGGER SEEKS HITS IN HOLLYWOOD

A chance encounter with bad-boy actor Charlie Sheen helped Major League Baseball veteran **TODD ZEILE** get ahead as a TV producer. Can he elevate his game?

By Albert Chen

For more great business stories in our Pro-Files series, check out both Fortune.com and SI.com.

FOR MANY BASEBALL LIFERS, retirement from playing leads seamlessly to a gig as a bench coach or a TV talking head. For Todd Zeile, it led to a trip to Scotland with Charlie Sheen to find the Loch Ness monster. "One night we went out on this tiny wooden rowboat, with a bottle of Scotch," he recalls. "I did the rowing. It was cold and dark. Calm—but kind of ominous." So: Any sightings of Ol' Nessie? "Well, Charlie will tell you we almost got capsized because of a very mysterious undercurrent."

It's a radiant May afternoon in the San Fernando Valley, and Zeile is having lunch on a terrace at a country club near his home, explaining how a mild-mannered major-leaguer became bros with a notorious Hollywood bad boy. When he retired from baseball in 2004, Zeile sought an alternative to the traditional ballplayer afterlife. He dabbled in real estate (getting burned when the market tanked in 2008). He tried his hand as an aviation entrepreneur (with better luck).

And then there's the Hollywood thing: Over the past decade Zeile has worked as a film and TV producer, enjoying his biggest success with Sheen's sitcom *Anger*

PHOTOGRAPH BY SAM COMEN


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Management. But he has also hit plenty of bumps along the way, learning that if there's one thing as hard as making it in the major leagues, it's making it in entertainment.

HIS FORMER MANAGER, Joe Torre, calls Zeile the Forrest Gump of baseball, and the movie analogy holds true: He's played a supporting role in some historic moments. Over 16 seasons, Zeile played for 11 teams. He played third base for the Baltimore Orioles alongside Cal Ripken the night the Hall of Famer broke Lou Gehrig's consecutive-games streak. He played in the first-ever Subway Series, and was the Mets' first baseman the night baseball returned to New York City after 9/11. And Zeile wasn't merely a wallflower: He was one of the top power-hitting third basemen of the 1990s, retiring with 253 homers and 2,004 career hits.

Zeile made his first foray into business in his playing days. In 2002, after a midseason trade, he wondered how he would get his family to fly to visit him, and had the idea of starting a company to charter flights for athletes and celebrities. Zeile partnered with Bill Borgsmiller, the president of a small aviation firm. With Zeile as an investor and rainmaker, Aviation Consultants Inc. grew its fleet from two planes to 10 and is thriving today. "Nothing rattles Todd ... and as you go through ups and downs, that's a very good thing," says Borgsmiller.

Having grown up in Los Angeles and played in New York and L.A., Zeile had long been intrigued by the entertainment industry. During his playing days, he invested in the movie *Dirty Deeds,* a high school comedy. Zeile even had a bit part, as a mullet-wearing street bum. "I thought, Hey, this is fun," he says. "This gives me something to transition into." But *Dirty Deeds*, released in 2005, was critically panned, and Zeile lost millions, "more than I would have paid in tuition if I'd gone to film school for 10 years," he says. "It was a great education, but a costly one."

Zeile hit three home runs for the Baltimore Orioles during the 1996 American League Championship Series.

SPORTING NEWS—GETTY IMAGES

ONE FRIGID NIGHT IN 1998, when Zeile played for Los Angeles, he was in the Dodger Stadium tunnel warming up his hands before an at bat when he heard a voice boom, "Dude, can you point me to my seat?" It was Sheen, who had just wandered in from the parking lot. A baseball fan whose screen roles included star turns as an erratic pitcher in the Major League movies, Sheen recognized Zeile too.

The two eventually became friends and travel companions. Over the years they've played catch—over glaciers in Alaska, while swimming with dolphins in Cabo, and at countless ballparks. "People don't get it," Zeile says of their relationship. "I've never been a partier. I don't drink. For whatever reason, I became a solid influence for Charlie."

That opened the door to Zeile's biggest role yet in Hollywood. In 2011, Zeile was looking for a new project after financing *I Am,* a retelling of the Ten Commandments story. Sheen was doing a comedy tour, and Zeile was on the bus with him coming up with bits, when the news came that Sheen (whose contract demands and behavior had been making headlines) had been dismissed from his TV series, *Two and a Half Men.*

Pondering his next move, Sheen got excited about a pitch of Zeile's—a show in which a former baseball player copes with life after the game. The two retooled the idea, and it became part of the DNA for *Anger Management,* in which Sheen starred as a baseball player-turned-therapist. Zeile was a co-executive producer, an amorphous title: In practice, he was on set every day to keep Sheen focused and chime in on story ideas. The show's pilot, which aired in June 2012, attracted 5.74 million viewers, making it the most watched sitcom premiere in cable history, and the series had a breathless 100-episode run that ended in December.

> **"PEOPLE DON'T GET IT. I'VE NEVER BEEN A PARTIER. I DON'T DRINK. [BUT] FOR WHATEVER REASON, I BECAME A SOLID INFLUENCE FOR CHARLIE."**
> *—Todd Zeile*

Anger Management gave Zeile a steady paycheck and a track record that may help him line up future work; he and Sheen have been discussing new film and (non-sitcom) TV projects. Zeile is also working with an investment group, G2, on an initiative to bring water-purification products to developing countries. He'll be spending a week in Ghana and other African nations this summer, meeting with local officials. But his primary focus is hustling in Hollywood, with the plug-away mentality that served him well in baseball. "I can say that all this has led to some interesting adventures," he muses.

Venture

HOW I GOT STARTED

Interview by Dinah Eng

J.D. Power on the front porch of his home, in Westlake Village, Calif., with his dog, Blue

DRIVING CHANGE IN CAR RESEARCH

J.D. POWER'S name is synonymous with independent market studies today—but companies didn't always want to hear what his work revealed.

JAMES DAVID POWER III, 84, *built a business selling auto companies something they didn't initially want: their customers' opinions. Detroit carmakers in the 1970s weren't interested in independent reports about their shortcomings. But Japanese rivals, he says, were "fanatical" about understanding the American consumer and signed up for his surveys on quality. That established his foothold. Today dozens of industries vie for top rankings from J.D. Power and Associates, which had estimated revenues of $269 million in 2014 (it's now owned by McGraw Hill Financial), and such surveys are a business staple. Power's story:*

Market research has changed a lot over the years. I grew up in Worcester, Mass., and studied English at College of the Holy Cross. My father, who was an English teacher, said, "Don't go into teaching." So after college I spent four years on an icebreaker in the Coast

PHOTOGRAPH BY ANNIE TRITT

Guard, and when I got out, I got an MBA in marketing at Wharton. One of my first classes was marketing research, and I decided that's what I wanted to do. I graduated in 1959, and ended up at Ford Motor.

I like analyzing what's going on. Back then, people weren't doing market research correctly, especially the car companies. Market research reported to sales, so it had to come up with results that reinforced decisions the sales department was making. Researchers interviewed people and just tortured the data till it confessed.

I wanted a change, so in 1961, I took a job with Marplan, the research arm of McCann Erickson, and later moved my family to Los Angeles. I did studies for Reddi-wip, Kal Kan Dog Food, U.S. Borax, and others. When the McCulloch Corp. [a maker of lawn mowers and tractors] offered me a job as director of corporate planning, I took it.

One day a friend from Wharton came to town with two other fellows. All three had quit their jobs to come to California to meet with people in the aerospace industry. They wanted to measure household utility meters by satellite. It was 1968, so they were thinking ahead. I asked, "You've each got kids and are giving up good jobs?"

One of them said staying in the same job is something people may do to get ahead, but you become a captive of the company. I told this to my wife, Julie, and she said, "Why don't you start your own company?" So I quit my job. I immediately got a call from Mr. [Robert] McCulloch himself. They were concerned I might do work for a competitor. So he retained my services for two years. For five days a month I was paid my full salary of $15,000 a year, which was a lot back then.

We used that to start J.D. Power and Associates at our kitchen table. With my background, I thought we could do market research in areas the auto industry wasn't paying attention to.

Toyota's U.S. headquarters was in Torrance, Calif., and I spoke to the advertising manager, who was in charge of research. He told me over the phone that he wasn't interested. So I decided to go down there. I noticed forklift trucks in a display, and asked to see the person in charge of that. I told him I'd do a good report on what was going on in the U.S. on forklift trucks for $600. He was delighted with the report, and before long I was introduced to Tatsuro Toyoda, the son of the company founder. We talked, and I sold him on my experience in the auto industry. I then went on to do a study on imported cars to help Toyota understand the competitive landscape.

In the early years, I put our kids to work on the survey mailings; Julie supervised. We taped a quarter on each cover letter as an incentive to answer, and that got us a 60% response rate. In the 1990s we switched to a fresh $1 bill. Before long we got an office to look more professional, and I hired some former Marplan colleagues.

We were the first to do independent research studies on the auto industry. The first reports on customer satisfaction were purchased by Japanese auto companies. People said we were in bed with the Japanese while Detroit was suffering. But the CEOs of the U.S. manufacturers became interested in our data because they found that their internal surveys weren't accurate.

MY ADVICE

JAMES DAVID POWER III
Founder, J.D. Power

BE ACCESSIBLE TO YOUR EMPLOYEES. I would walk around at 5 p.m. to see who was still working after quitting time. I'd ask everyone, "What are you working on? Any difficulties? Any suggestions?"

HOLD INTERNAL FOCUS GROUPS. We had frequent employee meetings, mixing all levels and divisions. No one was criticized for surfacing problems. It took a half day and a lunch or dinner to get together, but the information we gained was worth it.

HIRE PROBLEM SOLVERS. Whatever the job was, we didn't want just experts. We wanted people who had an intellectual curiosity and who had the characteristic of wanting to solve problems.

Then, in 1980, my wife was diagnosed with multiple sclerosis. Julie went from a cane to a walker to a wheelchair to an electric wheelchair. But she still went with me to meetings and knew all of our key clients. She'd tell me afterward what we should be doing.

Our biggest challenge was cash flow. When there was no contract work, we'd sell subscriptions to a report. As we grew, the cash flew out, and when the car companies were in trouble, they'd be slow to pay. It took us 15 to 20 years to really get stable.

I had a flair for seeing trends in data. As our experience became widely known, we got phone calls asking, "When are you going to do studies on banks or hotels?" We began researching other industries.

In 1992, Acura wanted to advertise its No. 1 ranking in sales satisfaction. So we developed the J.D. Power Awards to honor the winners of our studies. By the early '90s, every car manufacturer had to subscribe to us. It had taken decades to win people over.

In 2002 my wife passed away from MS. That really hurt my initiative. We sold to McGraw Hill in 2005, and I stayed on. Four years later I left to work on other boards and investments and set up a family foundation.

I'm proud of the impact we've had on improving the quality of products and services. Before the '60s, nobody really cared what the consumer thought. We made the term "customer satisfaction" part of the vernacular of business today.

Wells Fargo introduces the Business Plan Center, with complimentary tools and learning resources.

Like most small business owners, Emily Mansilla* is so busy running her business that she rarely has time to measure how she stacks up against her competition. Now, the Competitive Intelligence tool is helping her focus her advertising around her biggest opportunities. It's just one of the complimentary resources in the new Business Plan Center. **To learn more, visit WellsFargoWorks.com.**

Wells Fargo Works *for Small Business*

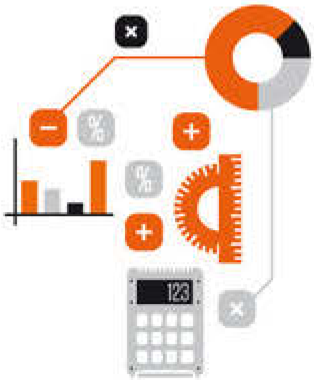
Together we'll go far

*Wells Fargo rewarded Emily Mansilla $10,000 to help with her marketing plans.

5 Ways to Turn Precision Into Profits

WHOEVER HAS THE MOST EXACT DATA—AND KNOWS HOW TO USE IT—WINS TODAY.

By Verne Harnish



CREATE A MATH DEPARTMENT

It's not just the Ubers of the world that need access to a designated team of quants. A math department is the hottest new function of the 21st century for companies in every industry. To grow successfully, you need precise data analysis driving all key decisions—inventory, routing, pricing, and staffing. Otherwise, you're just winging it—and you'll never make the most of your marketplace.

USE DYNAMIC PRICING

Amazon is constantly changing its prices, and so are airlines—and customers don't balk. But most entrepreneurs are afraid to do the same thing, and that's one reason they struggle to compete with Goliaths. Quit leaving money on the table. Instead, invest in software that enables you to use dynamic pricing too. The software isn't cheap, but it beats going out of business because you couldn't profit from periods of peak demand.

TRY "MASK" MARKETING

Many companies miss out on sales because they limit themselves to using thousands of keywords in their search engine marketing (SEM). You'll get the best results if you use a new automated technology called MASK, an acronym for massive array of structured keywords. It employs millions, rather than thousands, of keywords. The method was developed by Gauss & Neumann, an SEM research lab staffed by Ph.D.s. For one big airline client that used it, says CEO and co-founder Alberto Cabezas-Castellanos, "sales went up 53% in one year."

MAP IT

This column is about data—but you also need to know when to go beyond it. For example, are you trying to figure out where to expand next? Don't expect your team to make the right call by studying Excel spreadsheets. Map out the data and put it on the wall so they can see exactly where there are gaps in your coverage. When I used this technique in my own coaching network, it was immediately clear where we should put down a stake next.

CRAFT PRECISE PITCHES

You'll intrigue potential customers more if you tell them your service will save them $7.82 per unit rather than it's "nearly $8." Says Tom Sant, author of *Persuasive Business Proposals:* "Specificity is what gives people confidence in your message." Even better, use graphics that illustrate the financial impact of your product or service—whether that is improving sales, saving money, or increasing employee happiness. It's a powerful way to stop prospects from merely skimming your marketing materials.

VERNE HARNISH IS THE AUTHOR OF *SCALING UP*.

ILLUSTRATIONS BY MARTÍN LAKSMAN

Invest

SPIN-OFF STOCKS

PICKING UP THE PIECES AFTER A BREAKUP

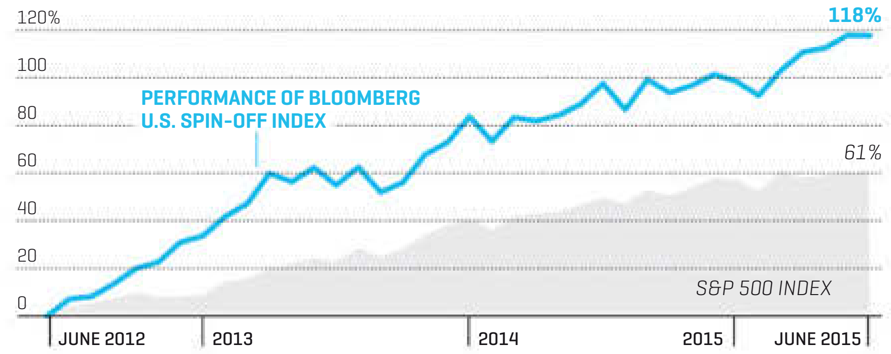
Investors are often wary of the stocks spawned by corporate spin-offs. That gives braver buyers a big pool of bargain-priced companies to choose from.

By Jen Wieczner

IN EARLY 2013, when Abbott Laboratories spun off its pharmaceutical division as a new company, AbbVie, investors initially shunned it. Some saw AbbVie's products as dead weight, begging to be jettisoned so that Abbott's faster-growing diagnostics and nutrition businesses could soar.

Within a few months, though, AbbVie picked up steam. Its new arthritis drug, Humira, took off to become a global bestseller, and as that and other hits boosted sales, they had an outsize impact on the bottom line—and share price—of the tightly focused new company. AbbVie has returned 117% since its launch, nearly

ILLUSTRATION BY MATT MURPHY



double Abbott's 64%. And Brian Gillott, who helps manage $4.1 billion for Prudential's Jennison Associates and bought AbbVie this spring, says its arc shows the potential of a smart spin-off. "Companies are better able to manage their business when their life depends on it," says Gillott. It's preferable, he adds, to "being the unloved stepchild."

Plenty of emancipated stepchildren will be seeking investors' affection this year. Parent companies worth a combined $1.5 trillion will execute spin-offs in 2015, more than twice the value of those that broke up in 2014, according to the Edge Consulting Group and Deloitte. Cases like AbbVie's show why some investors see spin-offs as buying opportunities. What's more, they're often bargain stocks. Splitsville scenarios, often pushed by activist investors, typically feature arguments that incompatible business units are holding a company back. Perceived as underachievers after such trash talk and unfamiliar to many analysts, spin-off stocks often sell at a discount for their first several months on the market. "That, frankly, is the hallmark of a lot of spins—low expectations," says David Hoffman, a portfolio manager of the Columbia Mid Cap Value Fund.

But over the longer term, those expectations are often wrong, especially when the spin-offs are themselves big businesses. The Bloomberg U.S. Spin-Off Index includes spin-offs with a market value of at least $1 billion at birth, tracking them for the first three years of their lives. It has returned 118% over the past three years, compared with 61% for the S&P 500. Since its 2002 inception, its returns have been 4.4 times the broader market's. Some of that outperformance is due to takeovers of newly bite-size spin-offs. But the benefits of splitting from a bureaucratic parent—including more accountable management and a separate bank account—can also fuel growth.

Recent big breakups have given investors a crowded field of large spin-offs to choose from. And 2015's pending splits include tectonic fractures of behemoths including HP (spinning off its personal-computer and printer segments) and eBay (shedding PayPal). But some investing pros say that lower-profile breakups offer more value because the stocks are typically cheaper at the time of the split.

Laton Spahr, who manages the Oppenheimer Value Fund, says his sweet spot for spin-offs is a market cap between $5 billion and $10 billion—not gigantic, but big enough to draw mainstream investor interest that bolsters the stock. He recently invested in student-loan giant Sallie Mae, entitling him to ground-floor shares when Sallie Mae spun off loan-servicing unit Navient in May 2014. Navient, now worth $7.6 billion, has returned 20% since then (and made its debut at No. 463 on the *Fortune* 500). Its shares retreated recently, as loan reforms reduced the amount it gets for collecting on overdue payments. Still, Spahr thinks Navient should benefit as a healthier economy spurs more kids to go to college and drives down default rates.

Tom Bastian, portfolio manager of the $14.3 billion Invesco Equity and Income Fund, buys spin-offs after they start trading independently but before analysts start covering them. During one such window he bought Voya Financial, the 2013 spin-off of the former U.S. insurance and retirement arms of Dutch financial giant ING. Shares of Voya (another *Fortune* 500 newcomer, at No. 268) have more than doubled since, but still trade at less than 14 times expected 2015 earnings, below the market average. Already one of the larger 401(k) plan providers, overseeing $486 billion in assets, Voya is "ramping up" and improving its margins, says Bastian.

Parent companies also tend to beat the market after breakups, though not as dramatically as spin-offs do, and some investors buy companies that announce separation plans, aiming to own both parent and stepchild. Oppenheimer's Spahr owns conglomerate Danaher, which announced in May that it will spin off its industrial divisions, leaving the original Danaher to focus on life-science and water-quality businesses. Spahr invokes the Hydra legend: "Split the worm in half, and it grows two new heads. Now we've got two great companies."

Stephen Goddard, who oversees $10.1 billion as chief investment officer of the London Co., likes Energizer, which is about to spin off its namesake battery business. Energizer will retain its personal-care business (including Schick razors), which is growing fast, particularly in emerging markets. But investors who own it pre-split are "basically getting the battery business almost for free," Goddard says, and when "the sum of the parts is worth more than the whole, that's where the opportunity comes."

GRAPHIC SOURCE: BLOOMBERG

Tech

THE BREAKDOWN

By Katie Fehrenbacher

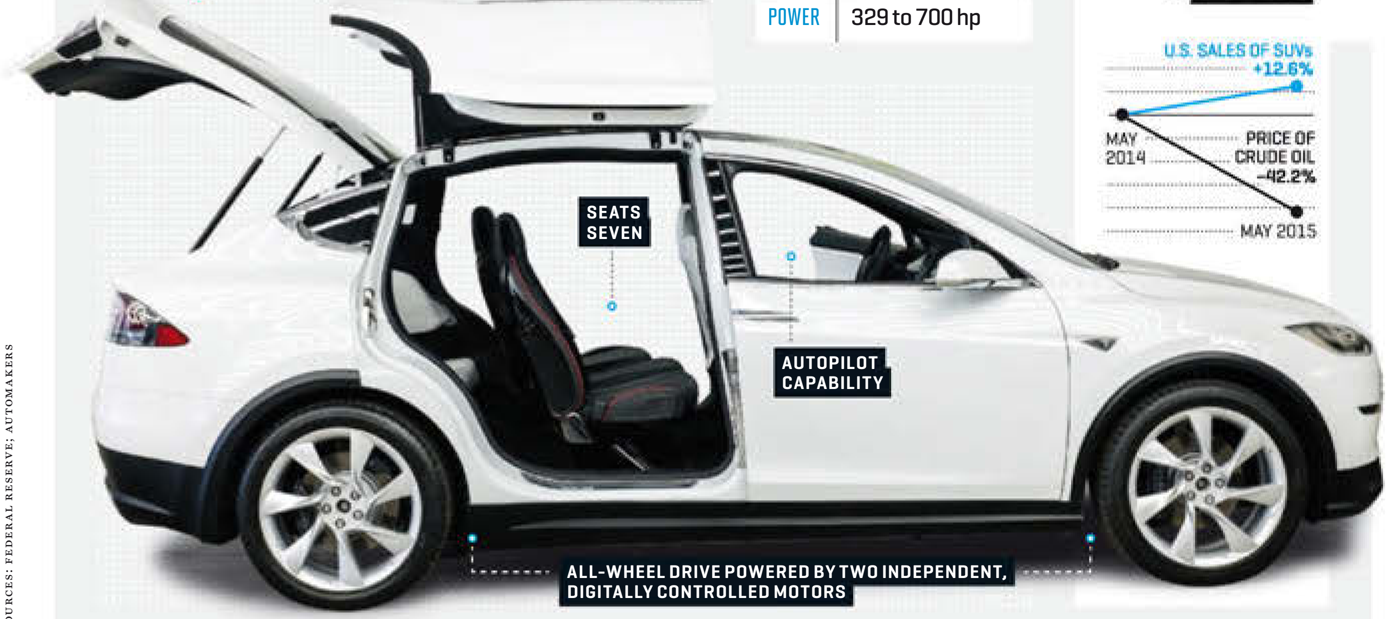
“THE MODEL X MAY ARGUABLY BE A BETTER SUV THAN THE MODEL S IS A SEDAN.”

TESLA CEO ELON MUSK AT THE COMPANY’S ANNUAL SHAREHOLDER MEETING IN JUNE

TESLA MODEL X

Tesla’s hotly anticipated, long-delayed third model—not to be confused with the upcoming Model 3—is expected to ship this fall. It’s been a long time coming. The success of the all-electric crossover vehicle is crucial for Tesla’s mainstream automaker ambitions, testing its production capacity and ability to appeal to parents who take family trips to Tahoe. Here’s a look.

PRICE	$70,000–$105,000
RANGE	215 to 270 miles
POWER	329 to 700 hp



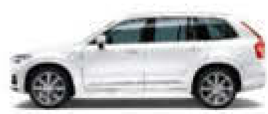
PREORDERS	More than 20,000	ACCELERATION	0–60 mph in 3–5 seconds	R&D	$426 million in Q1 Tesla capital expenditures*

*MAJORITY EARMARKED FOR MODEL X PRODUCTION

THE COMPETITION

BMW X5 EDRIVE

PORSCHE CAYENNE PLUG-IN HYBRID

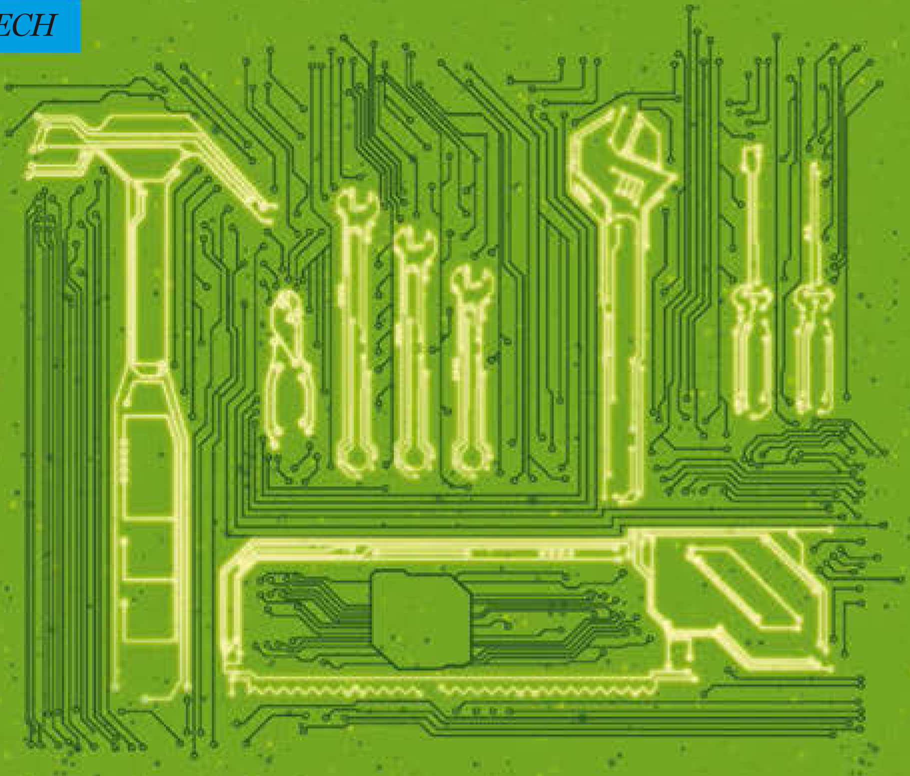


VOLVO XC90 PLUG-IN HYBRID

AUDI Q6 E-TRON (Q7 PICTURED)

MUSK: JASON MERRITT—GETTY IMAGES; CHART SOURCES: FEDERAL RESERVE; AUTOMAKERS

PHOTOGRAPH BY BEN LOWY—CONTOUR BY GETTY IMAGES



Sears' Big-Data Strategy? Just a Service Call Away

The largest repairer of home appliances in the U.S. goes digital by embracing its analog repairmen. *By Phil Wahba*

I**F YOU'D LIKE** to see less of your Sears repairman, rest assured, the feeling is mutual.

The venerable (but unprofitable) department store, which is the single largest seller of home appliances in the U.S. and installed 4.5 million of them last year, recently opened a new technology center in Seattle. One of its mandates? Mine data gleaned from the tens of millions of visits that Sears technicians have made to American homes over decades to more effectively diagnose a problem that an air-conditioning unit or dishwasher is having—well before a service call is made.

That's right: The Sears repairman, clad in his royal-blue shirt, is as valuable a data vehicle as a cookie stored in your web browser. With 7,000 technicians, Sears is the biggest repair service in the country, visiting 8 million homes a year. Its technicians have catalogued hundreds of millions of records, taking note of the location, model, and make—Sears services a wide array of brands, not just its own 102-year-old Kenmore line—on each visit, so its diagnostic technology can calculate the complexity of a repair as well as a cost and time estimate.

The upside of that data crunching? A reduction in the number of times Sears must dispatch technicians, saving the retailer a nice chunk of change at a time when its sales are flagging, sparing customers a lot of aggravation, and helping it snatch away business from competing repair services. Industrywide, service calls fix the problem on the first visit 75% of the time; Sears' lofty goal is to get that to a 95% resolution rate. (The company won't disclose its current rate, saying only that it is above average.)

"How do we leverage the data we have and our digital experience to disrupt a pretty sleepy industry?" asks Arun Arora, a former Staples and Groupon executive who now oversees home appliances and services for Sears. "We're going to use the digital backbone and data we have that we have not uniquely taken advantage of."

Its new facility also gives Sears a plum spot in the emerging market for smart home tech and services, something that fits well into CEO Eddie Lampert's strategy to revive the retailer and reinvent it by turning it into—what else?—more of a technology company.

SEARS HOLDINGS

COMPANY SNAPSHOT

RANKING 99

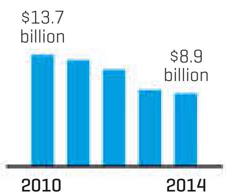
HEADQUARTERS
Hoffman Estates, Ill.

EMPLOYEES 196,000

REVENUE $31.2 billion

PROFITS –$1.7 billion

Sears sales of appliances, electronics, and other hard goods



GRAPHIC SOURCE: COMPANY FILINGS

ILLUSTRATION BY **MARINKO MILOSEVSKI**


When technology unlocks potential, brilliant ideas come to life.
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Smart. Flexible. And prepared for what's next. It's what every company needs to be. Including yours. That's why we bring the newest innovations to address your critical business challenges. We'll work with you to harness the power of emerging technologies, while getting the most out of your legacy IT. By combining our industry insights with technological expertise, we'll help you unleash the true potential of your business. That's high performance, delivered.
High performance. Delivered.
Strategy | Consulting | Digital | Technology | Operations
accenture technology


BREITLING
EMERGENCY


ALERT
LOCALIZATION
RESCUE
TURN ANTENNA
BREITLING
1884
INSTRUMENTS FOR PROFESSIONALS™

A LEADER WITH HIS HEAD IN THE CLOUD

Andy Jassy has turned AMAZON WEB SERVICES into the tech world's reigning provider of cloud-computing services. Can he defend that crown against aggressive competition?
By Leena Rao

MAJOR LEAGUE BASEBALL uses Amazon's cloud to send real-time updates of player statistics to fans in all 30 of its stadiums. Regulator FINRA uses it to store and analyze more than 30 billion stock market transactions a day. Netflix relies on it to stream billions of hours of video every month to 50 million customers in 60 countries. And given their reliance on Amazon, these big institutions have something else in common: In a sense, they all work with Andy Jassy.

While the world knows Amazon as an e-commerce steamroller, its cloud-computing division, Amazon Web Services (AWS), is now just as dominant in its own field, with almost three times the market share of its nearest

Jassy brought AWS to life just as the market for cloud services took off.

PHOTOGRAPHS BY JOSÉ MANDOJANA

competitor (see graph). AWS is a behind-the-scenes partner for more than 1 million customers, from tiny mom-and-pop shops to *Fortune* 500 leviathans, providing online infrastructure to support their websites, applications, inventory management, and databases. And since its inception 12 years ago, AWS has been shaped, led, and sold to customers by Jassy, a 47-year-old transplanted New Yorker who's been at Amazon since he finished his Harvard MBA.

The business world learned just how big AWS was in April, when Amazon for the first time broke out its numbers in a quarterly earnings report. AWS was not only profitable, Amazon said, but on track to earn $6.3 billion in revenue in 2015.

That announcement shone a spotlight on Jassy's accomplishments, but he didn't celebrate the milestone—at the time he was flying from Seattle to the Midwest to meet a customer. There's no time to bask in accolades, because AWS faces substantial new challenges, including growing competitive threats from cash-rich rivals like Google and Microsoft. Jassy says he knew this time would come: The surprise is that it took so long. "I don't think any one of us ever imagined we would have as much of a headstart as we did," he says.

JASSY, AMAZON'S senior vice president of web services, came to Seattle and joined the company in 1997. His background was in marketing and business development, not engineering, but Rick Dalzell, Amazon's chief information officer at the time, says Jassy exhibited some promising traits, including a photographic memory and a passionate competitive streak. (The latter quality is on display at Jassy's house, where the married father of two has built a downstairs sports bar where he can follow his beloved New York Rangers, Mets, and Giants.)

Jassy earned positive reviews early on for leading Amazon's music sales efforts, and in 2002 he was chosen as one of Jeff Bezos's "technical assistants"—staffers who train for senior executive roles by shadowing Amazon's CEO for a year or longer. It was during this stint that AWS first took shape in Jassy's mind.

At the time the cost of storing and processing digital information was a burden and an obstacle for many businesses. Data centers were cumbersome and expensive to build and often came with costly service contracts attached. Amazon, however, had in-house expertise in this field: To keep its e-commerce marketplace running smoothly, the company was constantly building new data centers.

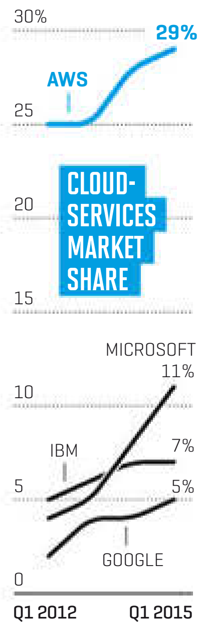
Jassy envisioned that Amazon could share its know-how and infrastructure with other businesses over the web, managing computing power for them so they could keep costs down—a concept now known as a "public cloud" model. Inspired, he labored over a pitch memo to convince Bezos and Amazon's board that the company could build a business around this idea. (Per Amazon's traditions, the memo couldn't run longer than six pages.) The idea of renting computing power from another company was almost unheard of, but Jassy had a key backer in Dalzell, who recalls arguing that "we're going to invest in this anyway," since Amazon would always need data-center resources for itself. In October 2003, Jassy got the green light.

Over the next 2½ years, Jassy's development team hewed to two principles. Amazon's service would be "pay for what you use" rather than require customers to buy a fixed amount of infrastructure upfront. The idea, Jassy says, was that "any individual in his or her dorm room should have access." And the system would be quickly scalable so that customers whose web traffic or data needs suddenly increased could instantly get access to more space on AWS's network.

In early 2006, just as the concept of cloud computing was gaining traction in tech circles, Amazon's cloud offering went live. Jassy focused his sales efforts on smaller firms and startups, companies for whom building data centers was financially impossible. Early adopters included file-sharing service Dropbox and lodging network Airbnb; as those outfits grew, they burnished AWS's reputation for being able to scale up. But AWS's breakthrough came in 2009, when media-streaming giant Netflix became the first big public company to operate 100% on AWS infrastructure. Netflix remains AWS powered today, using 30,000 to 50,000 "instances" (essentially, virtual

AMAZON OWNS THE CLOUD—AT LEAST FOR NOW

Amazon Web Services (AWS) built a big lead in market share in the early days of cloud computing; Microsoft, Google, and others aim to narrow the gap.



GRAPHIC SOURCE: SYNERGY RESEARCH GROUP

servers) to help viewers keep up with Kimmy Schmidt and Francis Underwood.

Netflix's adoption also gave other big companies and institutions the confidence to try AWS. Its heavyweight corporate customers now include Samsung, Comcast, and pharmaceutical giant Novartis, to name just a few. In 2013, AWS won a contract from the Central Intelligence Agency—a classified deal that became public knowledge when a competitor sued the government over it. Once that news broke, Jassy recalls, "a lot of companies would say, 'Well, if the security and performance is good [enough] for the CIA, then it's probably good enough for us.'"

Jassy at the Seattle offices of AWS, which now faces energized rivals

ANALYSTS WHO follow Amazon estimate that AWS's sales have risen roughly 40% a year since 2008. But AWS no longer has the field to itself. Microsoft's Azure public-cloud product and Google's Platform cloud made their commercial debuts in 2012 and 2013, respectively; database experts IBM and Oracle have also ramped up their own cloud efforts.

All these competitors are growing fast, but Microsoft is making particularly big strides. Amazon's crosstown rival makes much of the software bigger companies use for in-house data centers, and touts a "hybrid cloud" approach that coordinates cloud and on-site information. Senior vice president Scott Guthrie, who runs Azure, sees the field becoming a three-horse race (with Google as the third pony). "I give [AWS] credit for pushing the cloud earlier than others," Guthrie says, "but I don't think this is a market that's winner take all."

Microsoft and Google are also doing something that's familiar to any retailer who has ever competed with Amazon.com: They're engaging the incumbent in a price war. Kim Weins, vice president of marketing at Rightscale, a service that helps developers manage cloud services, estimates that AWS customers now pay half as much for the same services as they did at the beginning of 2013 and that Google's prices have fallen 62% over that span. The decline partly reflects falling hardware prices, Weins says, but competitive price cutting has also been a major factor.

To shore up its lead, AWS has added new features to its own hybrid-cloud product, Direct Connect, and is more aggressively marketing it; it's also offering email management and the ability to collaborate on documents. "Every incremental feature helps make the AWS platform stickier for customers," says Lydia Leong, an analyst at research firm Gartner.

Leong and other tech analysts see Amazon's decision to unveil AWS's numbers as a statement to clients and competitors alike that AWS has the scale and profitability to remain dominant. But some in corporate finance perceive it as a subtle FOR SALE sign. Jim Osman, president of investment research firm Edge Consulting Group, says AWS is a good spin-off candidate, given its strong balance sheet and the disparity between its services and Amazon's core e-commerce business. Jassy's take? "I've learned at Amazon in my 18 years to never say never about anything," he says, "but I don't anticipate that."

Instead, he's focusing on rebuffing his competitors, and contemplating the prospect with confidence. "We've operated for a lot longer and have a much, much larger-level scale than the other providers," Jassy says. "You learn lessons you just can't learn until you get to that level."

Fantastic Non-Plastic

ONE COMPANY'S 100% BIODEGRADABLE STROKE OF BRILLIANCE

FLOATING BETWEEN America's West Coast and Japan is the Great Pacific Garbage Patch: tragically the size of Texas, containing pieces of toxic un-recycled plastic debris that will not degrade anytime soon. It is a scary symbol of the massive global problem posed by all the non-sustainable petro plastics we use every day—but one company has a solution.

Biopolymer leader MHG is producing PHA (polyhydroxyalkanoates), a product that fits the bill. The 100-employee company based in Bainbridge, Ga., collaborates with farmers to sustainably grow non-GMO canola, harvest the seed, and crush it into oil. Then, under the guidance of inventor Isao Noda, world-class scientists—many from the University of Georgia—perform a kind of alchemy in the company's 1-million-square-foot facility. Using Nodax™ biopolymer technology employing plant-based fatty acids, they turn the oil into a completely customizable replacement for plastic. Materials produced through this process biodegrade within weeks, under virtually every condition, and have earned coveted certifications such as Vinçotte.

> If we try, we really can live in an eco-friendly world and change the way that we handle waste and waste management forever."
>
> **PAUL PEREIRA,** Executive Chairman and CEO, MHG

The company, which owns 123 patents across nearly 20 countries, is on a roll. MHG's remarkable new material is successfully challenging unsustainable petroleum-based plastic in price and performance. As a result, the company's products—and its growth potential—are attracting the attention of *Fortune* 500 companies around the world.

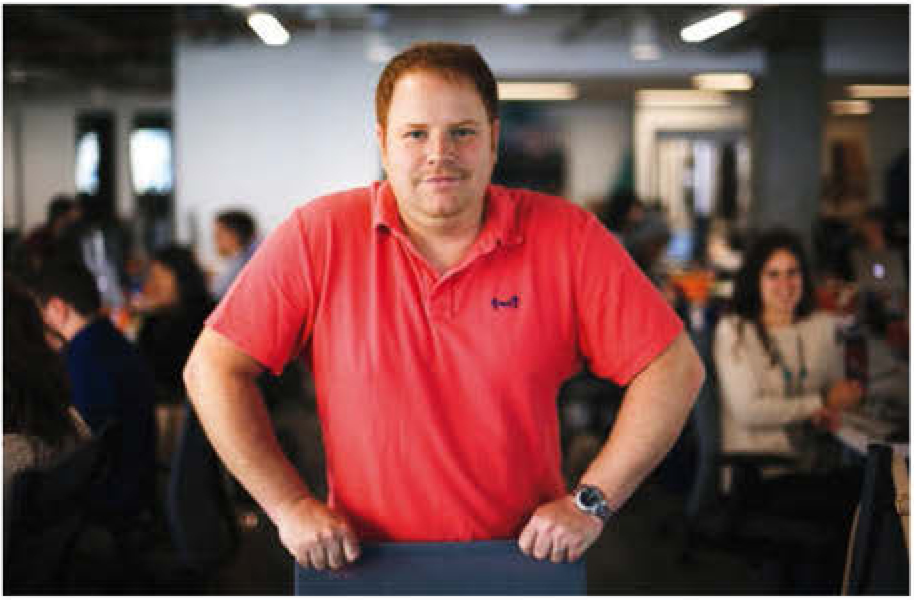
"MHG's commitment is to the environmental, social, and economic well-being worldwide through the application of renewable and sustainable products," says Paul Pereira, executive chairman and CEO. "In the future office, you might very well find drywall bound together with Tate & Lyle eco-friendly, non-synthetic starch from MHG. You might also see petroleum-free sandwich bags, straws, cups, cutlery, and single-cup coffee cartridges. At present, our daily consumption using these petro-plastic coffee cartridges is enough to circle the globe. So consider what removing that kind of garbage could mean."

3-D printers could use MHG Nodax PHA to make architectural models and medical appendages, such as customized braces.

"The applications are endless," says Pereira. "If we try, we really can live in an eco-friendly world and change the way that we handle waste and waste management forever. The biggest challenge is changing humanity's habits. Our science is showing the way."

THE ENFANT TERRIBLE OF THE BACK OFFICE

Parker Conrad thinks the business of human resources needs a shake-up. His stark words—and well-funded startup ZENEFITS—have ignited an industry. ***By Erin Griffith***



Zenefits CEO Parker Conrad at the company's (increasingly crowded) San Francisco headquarters

JIM WILSON—THE NEW YORK TIMES/REDUX

ZENEFITS HAS been banned, demonized, and, as of last month, sued. The San Francisco startup's public relations strategy is "manipulative and malicious," argues one competitor. Its business model is a "threat," according to insurance brokers. Two years into its life, Zenefits, which makes software to help small businesses manage their human resources operations, is bringing buzzy excitement to an otherwise dull sector. There's even a touch of Hollywood, with actor (and Zenefits investor) Jared Leto tweeting furiously in support of the company in between his usual selfies.

Through it all, Parker Conrad, Zenefits' 35-year-old founder and CEO, has colorfully defended his company's right to disrupt. Insurance brokers? "Fucked," he told *Fortune* last year. Regulators in Utah, which temporarily banned the company's services? "Blatant overreaching," Conrad says. The legislation itself? "Kafkaesque." When Automatic Data Processing, the $40 billion HR services company, sued Zenefits in June, Conrad launched the Twitter hashtag #ADPeeved.

With its stated goal of eliminating middlemen like insurance brokers, Zenefits has become a threat to its entrenched competition faster than most startups. The company scored 10,000 customers in two years. It booked $20 million in revenue last year and says it is on track to quintuple that figure this year. Zenefits lured Silicon Valley heavyweight David Sacks, of Yammer and PayPal fame, to run its operations. (Sacks says Zenefits is "the coolest company I've ever seen, maybe ever.") With more than 1,000 employees, Zenefits is adding people so fast it must onboard them in monthly batches of 150 at a time.

That growth has made Zenefits a darling of Sand Hill Road investors, who poured nearly $600 million into the company at a valuation of $4.5 billion. The lofty figure helps the startup gain credibility with potential customers and recruits. It also puts a target on the company's back.

Hence the ADP lawsuit. The 66-year-old New Jersey company (which, for the record, takes in $12 billion in annual revenue) has charged Conrad and Zenefits with defamation, false advertising, intentionally interfering with customers, and unfair competition. (Zenefits denies the allegations.) When ADP blocked Zenefits' access to its payroll data—for security reasons, it maintains—the startup escalated the squabble by offering 850 mutual clients $1,000 to switch to a different payroll provider.

Conrad—who graduated from Harvard after flunking out, beat testicular cancer at 24, and was pushed out of his previous startup, SigFig, by his own co-founder—isn't one to back down: "If you're dealing with a bully, you've got to fight them. You've got to punch them in the face."


Q:
What will you do when everything is as smart as your phone?
Erase the boundaries between digital and physical.
Become a citizen of a much smarter city.
Let your car be the one looking both ways.
Redefine the classroom.
Live in a habitat shaped by your habits.
Why Wait™
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TECH TALENT: PLAY DEFENSE, OR TAKE UP ARMS?

Are noncompete agreements helping or hurting tech innovation? Depends on whom you talk to. (And in which state you're talking.) ***By Claire Zillman***

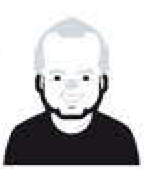
CALIFORNIA IS KNOWN for its sandy shores, soaring sequoias, and—if you're an employment-law wonk—its ban on enforcing noncompete agreements. The state's prohibition on fine print that prevents employees (not owners) from working for a competitor in their next job seems to sync with California's wild-and-free attitude. *"Go, man. Jump from job to job. Experiment!"*

It's ironic, then, that the section of California's professional code that disallows post-employment restrictions was originally written for New York State in 1865. New York never enacted the code, but in 1872, when California wanted to impose some order in its fledgling state, it adopted the language originally intended for its Eastern peer, including the ban on noncompetes. Today just three states have anti-noncompete language on the books. California, home to some of the world's largest technology companies, is by far the one with the most economic might.

That could soon change. Massachusetts, Rhode Island, and Washington also want to prohibit the noncompete. Bill sponsors draw a straight line between California's unregulated job market and the accelerating fortunes of Silicon Valley. Get rid of such restrictions to unleash local talent, they seem to suggest, and spark a tech boom. Opponents argue that the elimination of noncompetes would leave companies vulnerable to trade-secret theft, since employees could easily take their knowledge to a competitor. And there's evidence that the move could create unintended consequences as companies compete for unrestricted talent. Exhibit A: the escalating wages and proliferating perks for software developers in the Valley.

Which system better encourages innovation? The battle over the answer to that question has played out most prominently in Massachusetts, which has debated a bill to ban noncompetes at least

REGULATED OR FREE MARKET: WHICH CONDITIONS CREATE THE BEST TECH SCENE?



Damien Patton, CEO, Banjo
"This whole noncompete scenario stifles innovation. Without the ability to take what you've learned and apply it somewhere else, you have no ability to make your own destiny."

Christopher Geehern, EVP, Associated Industries of Massachusetts
"Our view is that this is a debate in search of an issue. Companies that use noncompetes still attract the biggest and brightest."

PORTRAIT ILLUSTRATIONS: MARTÍN LAKSMAN

ILLUSTRATION BY GWER


IBM Security:
Can your business manage 20 billion security events a day?
There's a new way to protect. IBM Security integrates deep analytics and industry expertise to help predict infection, block attackers and manage events throughout your whole organization. Disrupt new threats at ibm.com/madewithibm
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four times in the past six years (and for which memories of a miraculous 1980s tech-industry heyday still linger). Lori Ehrlich, a state representative who introduced a recent bill earlier this year, says she wants to eliminate noncompetes because they have an "overall impact of stifling innovation." It's a question of fairness, she says, especially when such agreements appear as requirements for jobs in low-wage, low-skill industries. Noncompetes "are being used to control and intimidate in a realm where the power already favors the employer," she says. It's not a matter of preserving trade secrets, she adds; there are already nondisclosure agreements to protect against such theft.

The Associated Industries of Massachusetts, a trade group, is one vocal opponent of the bill. Testifying before a state committee on economic development and emerging technologies, John Regan, executive vice president of government affairs for the group, said that Massachusetts's case law "strikes the right balance" between employee interests, such as career flexibility and financial incentives, and those of employers, like protection of intellectual property, trade secrets, and confidential information.

In 2007, Bijan Sabet, a general partner at Spark Capital in Boston, eliminated a company requirement that the startups in which his firm invested include noncompete clauses in their employee contracts. They have a chilling effect on the proliferation of ideas and innovation, he says. "If you're a graduate of MIT who studied a specialty like robotics and a Massachusetts company says, 'Come here and sign this noncompete,' and a San Francisco company says, 'We know this isn't your last job—do whatever you want,' which would you choose?" Noncompetes are one reason Boston startups have trouble finding talent, he says.

Matthew Marx, an MIT professor focused on tech innovation and entrepreneurship, says it's premature to conclude that the elimination of noncompetes results in more innovation. "I don't think we have the definitive answer," he says. But there is research that suggests that information flows more freely in places without noncompetes.

But so does money. The average salary of a software engineer in the San Francisco Bay Area is well over $100,000 a year, and companies must have the capital to compete. The absence of noncompetes means runaway salaries and a grab-bag recruiting scene where every individual—employed or not—has the potential to be poached. Combine that with the frantic pace of technological advancement, and you have a talent war waged in an otherwise calm Eden overflowing with tech ideas and talent ripe for the picking.

Damien Patton, CEO of Banjo, a social media analysis startup with offices in Las Vegas and Redwood City, Calif., says he recently interviewed (and hired) an engineer who had been wooed by 28 other companies. If the candidate's decision had depended mostly on salary and incumbent tech firms were in the mix, the battle would have been over quickly. "We don't try to compete," Patton says—on the basis of cash, anyway. Startups beat the giants for talent by luring recruits with equity and change-the-world passion. Once they're hired, ensuring that there's "upward momentum" keeps them onboard, Patton says. Employees look for other opportunities when their work gets stale.

That's how it should be, argues Orly Lobel, a professor at the University of San Diego School of Law. "If there was ever a competitive market," she says, "it should be applied to our greatest resource today: talent."

A BRIEF HISTORY OF ...

EMPLOYMENT BRAWLS IN SILICON VALLEY (AND BEYOND)

2015
JAWBONE VS. FITBIT
Weeks before Fitbit's IPO, Jawbone sued its wearable-tech rival for "systematically plundering" confidential info by hiring its San Francisco employees. (Fitbit denies the claim.)

2012
SAMSUNG VS. LG
Samsung accused six people employed by its Korean neighbor of stealing secrets related to its organic light-emitting diode technology. The rivals called a truce the following year.

2011
WORKERS VS. APPLE, GOOGLE, INTEL, ADOBE
The class-action lawsuit accused the Silicon Valley firms of conspiring to avoid poaching one another's employees. It was settled for $415 million in 2015.

2008
INTEL VS. AMD
The FBI found more than 100 pages of sensitive documents inside the Boston-area home of a former Intel employee who subsequently took a job with AMD. —*Andrew Nusca*

TECH

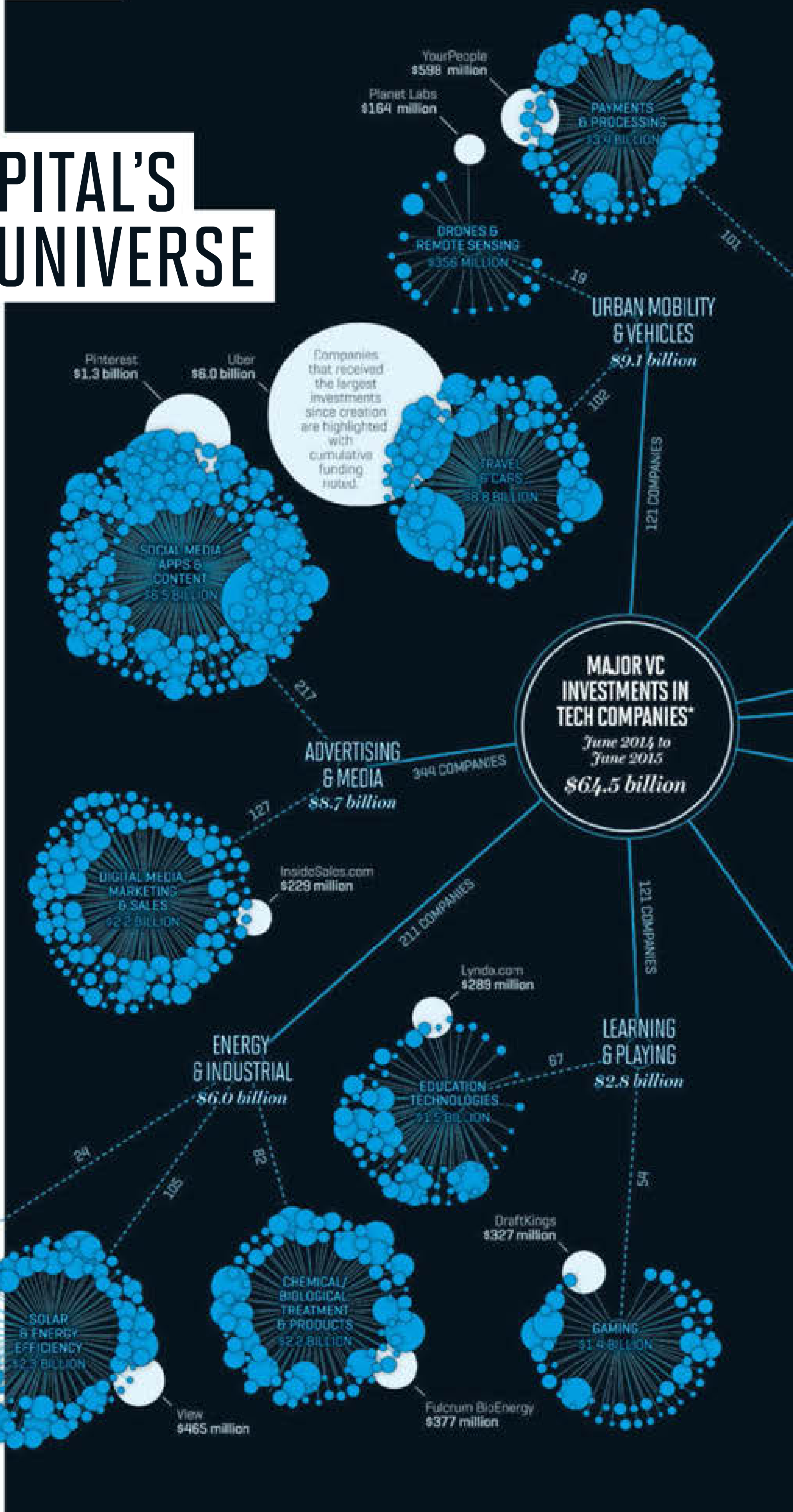
CHARTIST

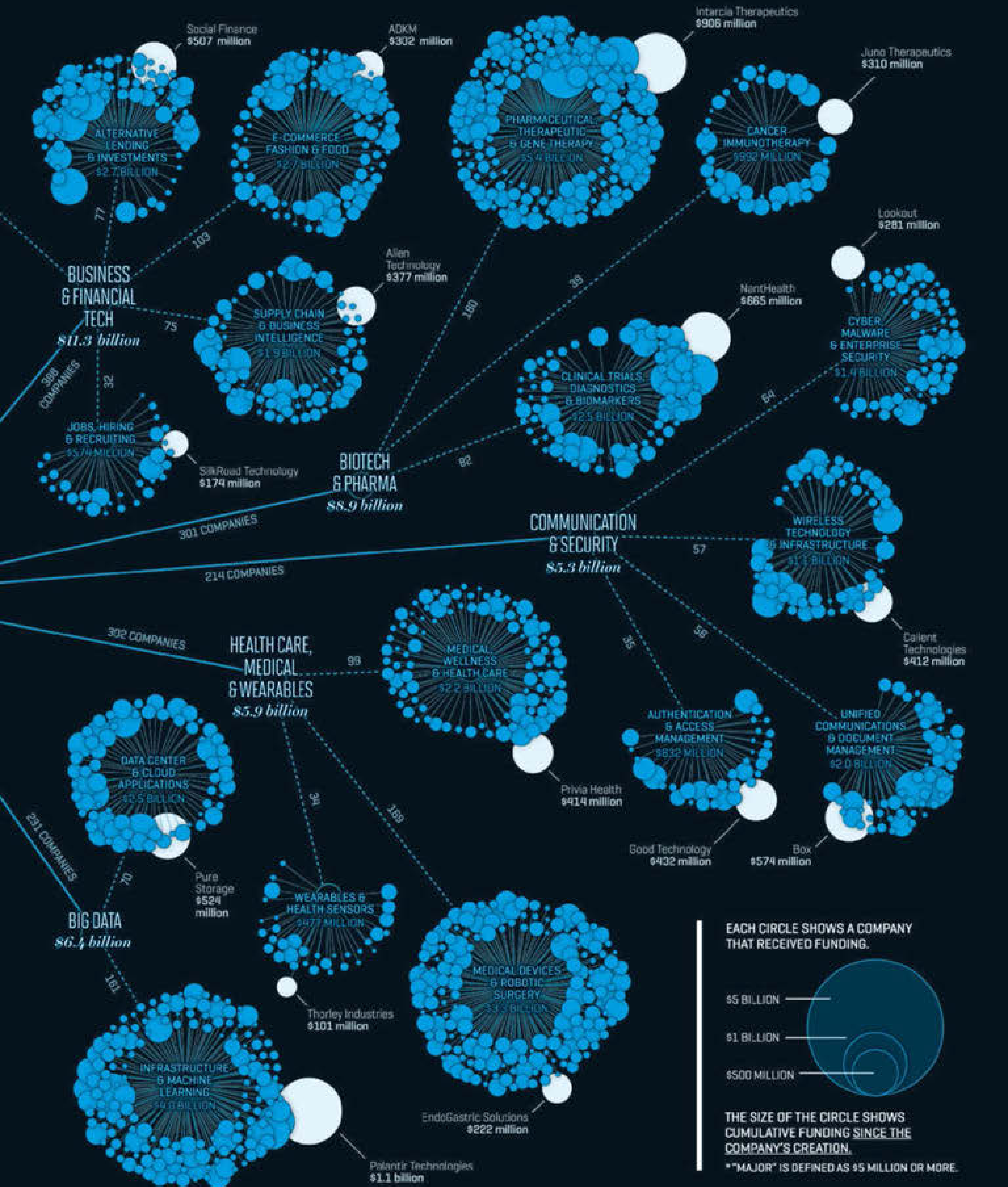
VENTURE CAPITAL'S EXPANDING UNIVERSE

Over the past year VCs have funded tech startups in virtually every corner of the economy.

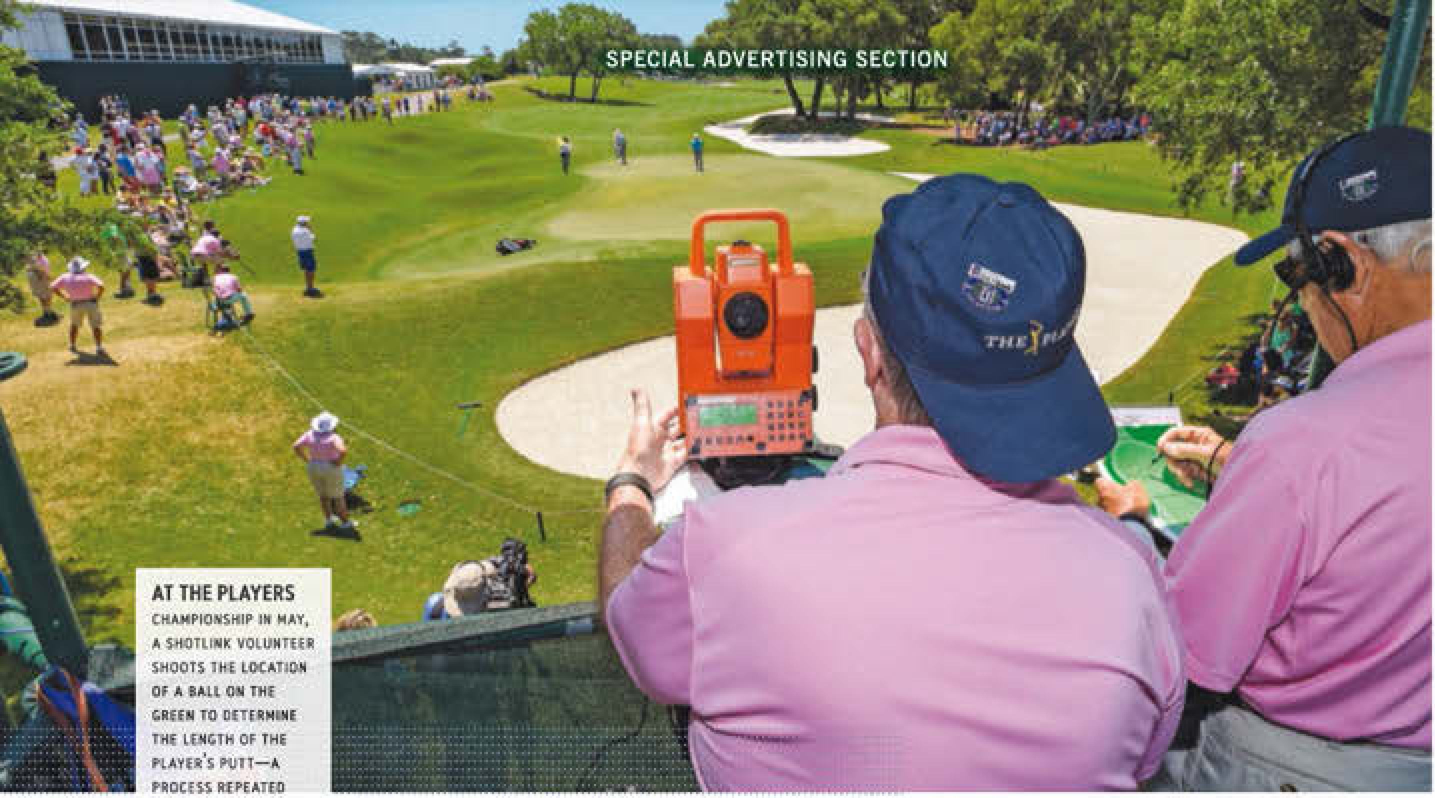
It's a good time to be dialing venture capitalists for dollars. So-called unicorns, tech startups with a valuation of $1 billion or more, continue to proliferate (*Fortune* found 104 at last count). But investment in private technology companies of all sizes is surging. To show the breadth of this boom, we turned to Quid, a San Francisco analytics company founded in 2010. Quid screened its proprietary database of companies with "novel technologies or products" for those that had received at least $5 million in VC money over the 12 months through June 1, 2015, and identified 2,233 in a range of industries. (Twenty that received investments have already had IPOs.) The $64.5 billion invested by VCs in these startups was 25% higher than the same period the year before and 92% higher than two years ago.
—*Stacy Jones*

Graphic by Nicolas Rapp
Data source: Quid





BUSINESS & FINANCIAL TECH
$11.3 billion
388 COMPANIES
ALTERNATIVE LENDING & INVESTMENTS
$2.7 BILLION
77
Social Finance
$507 million
E-COMMERCE FASHION & FOOD
$2.7 BILLION
103
ADKM
$302 million
SUPPLY CHAIN & BUSINESS INTELLIGENCE
$1.9 BILLION
75
Alien Technology
$377 million
JOBS, HIRING & RECRUITING
$574 MILLION
32
SilkRoad Technology
$174 million
BIOTECH & PHARMA
$8.9 billion
301 COMPANIES
PHARMACEUTICAL, THERAPEUTIC & GENE THERAPY
$5.4 BILLION
180
Intarcia Therapeutics
$906 million
CANCER IMMUNOTHERAPY
$932 MILLION
39
Juno Therapeutics
$310 million
CLINICAL TRIALS, DIAGNOSTICS & BIOMARKERS
$2.5 BILLION
82
NantHealth
$665 million
COMMUNICATION & SECURITY
$5.3 billion
214 COMPANIES
CYBER, MALWARE & ENTERPRISE SECURITY
$1.4 BILLION
64
Lookout
$281 million
WIRELESS TECHNOLOGY & INFRASTRUCTURE
57
Calient Technologies
$412 million
AUTHENTICATION & ACCESS MANAGEMENT
$832 MILLION
35
Good Technology
$432 million
UNIFIED COMMUNICATIONS & DOCUMENT MANAGEMENT
$2.0 BILLION
58
Box
$574 million
HEALTH CARE, MEDICAL & WEARABLES
$5.9 billion
302 COMPANIES
MEDICAL, WELLNESS & HEALTH CARE
$2.2 BILLION
99
Privia Health
$414 million
WEARABLES & HEALTH SENSORS
$477 MILLION
34
Thorley Industries
$101 million
MEDICAL DEVICES & ROBOTIC SURGERY
169
EndoGastric Solutions
$222 million
BIG DATA
$6.4 billion
231 COMPANIES
DATA CENTER & CLOUD APPLICATIONS
$2.5 BILLION
70
Pure Storage
$524 million
INFRASTRUCTURE & MACHINE LEARNING
161
Palantir Technologies
$1.1 billion
EACH CIRCLE SHOWS A COMPANY THAT RECEIVED FUNDING.
$5 BILLION
$1 BILLION
$500 MILLION
THE SIZE OF THE CIRCLE SHOWS CUMULATIVE FUNDING SINCE THE COMPANY'S CREATION.
* "MAJOR" IS DEFINED AS $5 MILLION OR MORE.



AT THE PLAYERS CHAMPIONSHIP IN MAY, A SHOTLINK VOLUNTEER SHOOTS THE LOCATION OF A BALL ON THE GREEN TO DETERMINE THE LENGTH OF THE PLAYER'S PUTT—A PROCESS REPEATED THOUSANDS OF TIMES EACH WEEK.

PHOTO BY STAN BADZ/PGA TOUR

BIG DATA ANALYTICS AND OTHER CUTTING-EDGE TECHNOLOGY ARE CHANGING THE GAME OF GOLF FOR PLAYERS AND FANS ALIKE.

Deep Drive

MOST GOLF FANS remember 2001 as the year Tiger Woods completed the historic "Tiger Slam," winning the Masters Tournament for his fourth consecutive major championship. Less recollected but with a similar impact: the 2001 introduction of the PGA TOUR's ShotLink System, a platform for collecting and circulating scoring and statistical data on every shot by every player in real time. ShotLink has changed the way TOUR professionals and officials prepare for events and provides a richer, deeper fan experience.

It has also helped lead to new tech-based initiatives such as PGA TOUR LIVE: Its digital Over-The-Top subscription service (in partnership with MLB Advanced Media) is set to launch later this summer with exclusive, live Thursday and Friday morning coverage of featured pairings from more than 30 PGA TOUR events per season.

A NUMBERS GAME

As the 21st century teed off, there were two kinds of TOUR pros: a handful of stats geeks, and everybody else. The former group visited the media center weekly to track the available numbers—by current standards, a rudimentary collection of basics such as driving distance, greens hit in regulation, and putting average—while the latter might have checked such data a few times annually, or not ever. So when PGA TOUR officials began to put three-page detailed statistical reports into players' lockers at each tournament, not everyone was appreciative.

"I remember one player came up to me and said, 'You're not gonna put that in my locker, are you?'" recalls Steve Evans, the TOUR's Senior Vice President, Information Systems. "When I asked him what the issue was, he said, 'Well, I'm ranked 180th in putts from 10 to 15 feet, and every time I set up over one of those putts, that's all I can think about!' We've come a long way since then."

Indeed, the thirst for minable data that drives the modern world also drives the modern pro golfer. A number of current PGA TOUR pros have added a data-analytics expert to their team of swing coach, short-game guru, trainer, massage therapist, sport psychologist, and caddie. How many, exactly? That's hard to say. While some pros like Brandt Snedeker have openly discussed such matters with the media, others don't want their competitors or the public to know what analytics they (might) use, or how.

"It's almost like their secret sauce," says Evans. "I relate it to the NBA. Most, if not all, teams are using data analytics extensively, but when you get them together at a conference, they talk very generically, because they think their methodologies are the best, and they don't want to cue the other teams to their perceived edge."

NEW INSIGHTS

Ball Chart by ShotLink—powered by the PGA TOUR's official technology partner, CDW—is one way that TOUR pros are employing data. This application, with data reaching back to 2001, shows players what scores were made on each hole for that day's pin position, color-coded for birdies, pars, bogeys, etc. Players can in turn plan their attack based on the patterns they discern from the day's results so far, or historically. A TOUR pro might see that being below the hole and to the right gives him the best chance for making his putt ... which might in turn lead him to try to place his drive in the left side of the fairway for the optimum angle to that spot.

ShotLink's utility in forging a winning strategy is plain to see. So, too, is its potential usefulness as a game-improvement tool. Evans recently spoke to a data-analytics expert who described his TOUR client's poor results on approach shots from 100 to 125 yards as being "out of whack" with the rest of his game. When the expert discussed this anomaly with the player, it became clear that the latter placed too much emphasis on landing his approach shots close to the pin. He wound up missing a disproportionate number of greens, not realizing that hitting more greens in regulation (and thus having more, albeit lengthier, birdie attempts) has proved to be a path to lower scores. Likewise, coaches are no doubt using deep data dives through benchmarking and checkpoints to devise off-season practice regimens and in-season tune-ups—just as

THE SHOTLINK OPERATIONS TRAILER GETS DATA ON EVERY SHOT BY EVERY PLAYER FOR EACH DAY OF COMPETITION THAT IT SENDS OUT TO THE BROADCAST TEAM, MEDIA CENTER, AND HOSPITALITY AREAS AND TO THE PGA TOUR'S DIGITAL EXECUTIONS.

PHOTOS BY CHRIS CONDON/PGA TOUR

A number of current PGA TOUR pros have added a data-analytics expert to their team of swing coach, short-game guru, trainer, massage therapist, sport psychologist, and caddie.

course architects are now using such dives to fine-tune the PGA TOUR's TPC Network of courses, and TOUR officials are doing the same to calibrate the setup of courses for tournament play. ShotLink's wealth of information also has yielded insights that have turned conventional golf wisdom on its head.

Likewise, the old saw "Drive for show, putt for dough" has been disproven. Using ShotLink data, Columbia Business School professor and *Golf* columnist Mark Broadie, in his book *Every Shot Counts*, demonstrated that there is more risk in tee shots and approach shots (where the penalty is potentially more severe) than in putting.

THE FAN'S PERSPECTIVE

As the forthcoming PGA TOUR LIVE subscription underscores, today's fans are likewise hungry to delve deeper into the game they love. They don't have access to the TOUR's Ball Chart, because they don't need it—they are generally concerned with following or reviewing the play. Instead, the PGA TOUR has created other, more relevant tools like Shot Tracker to strengthen fans' bond with pro golf. Whether on PCs, tablets, or smartphones, they can follow the shot trails of their favorite player, seeing what situation he was, or is, in, and how he dealt with it, on each and every hole.

ShotLink currently computes almost 500 stats—mostly available for general consumption on www.pgatour.com—and has affected fans' televised, "first screen" golf experience, too. The PGA TOUR supplies to the networks a broadcast graphic machine capable of putting up the text fans see during a telecast. The TOUR also embeds one of its own ShotLink analysts in the broadcast truck each week to mine the raw material for perceptive patterns that could be summed up in data visualizations for broadcast or broadcaster fodder. Some of these insights are new, including "Total Feet of Putts Made" (more than 100 feet connotes a great day on the greens). Some have become so commonplace that they risk being taken for granted. Consider, for example, the graphic showing the probability of a player making a putt given its distance.

"You're setting an expectation, and then when the player exceeds the expectation, the fan has a better appreciation for what he's done," says Evans. "One rationale of why we built ShotLink was our feeling that the best players in the world can make the game of golf look incredibly easy. The rest of us that play it know that it's not."

As any PGA TOUR golf fan knows, that's the most rock-solid insight of all.

—*Evan Rothman*

USING SHOTLINK TECHNOLOGY, VOLUNTEERS MONITOR PLAY ON THE 11TH HOLE DURING THE THIRD ROUND OF THE PLAYERS CHAMPIONSHIP ON THE PLAYERS STADIUM COURSE AT TPC SAWGRASS IN MAY.

PHOTO BY STAN BADZ/PGA TOUR

WOMEN TO THE FORE

THE PGA TOUR HAS SUCCESSFULLY PAIRED PROFESSIONAL DEVELOPMENT AND PERSONAL HEALTH.

WITH ITS ALL-MALE roster of players headlining a sport in which women comprise only about one-quarter of participants overall, the PGA TOUR might not seem the ideal place for a female-focused initiative. Then again, the TOUR's brand and product have always drawn a fiercely loyal following of powerful businesswomen in addition to businessmen who attend its events. This became evident to a PGA TOUR executive five years ago, when she had a eureka moment as she watched a large crowd of women standing in line for a cooking demonstration at a tournament sponsor's tent.

"I knew if we created specific programming for women, we could drive them out to the event even if they didn't play golf or even like golf," recalls Donna Fiedorowicz, then the PGA TOUR's SVP, Tournament Business Affairs and currently its SVP, Tournament Activation & Outreach.

What ultimately resulted was the PGA TOUR Women's Initiative, headlined by a series called Executive Women's Day. Beta tests of the concept at a handful of TOUR events all sold out. Duly impressed, Astellas Pharma US Inc. signed on as presenting sponsor.

The PGA TOUR and Astellas are now supporting more than two dozen Executive Women's Day events in tournament cities in 2015. (The TOUR is also currently seeking an umbrella sponsor to launch the same program on the over-50 Champions Tour.) Each follows a consistent format: A morning panel features three successful local businesswomen not engaged in the local speakers circuit sharing success stories and challenges alike, with the goal of helping attendees flourish professionally and personally; a behind-the-scenes tour of the event site exposes attendees to the intricacies of the PGA TOUR and its remarkable charitable endeavors; lunch features a national keynote speaker. The six-hour event concludes with a networking session, typically held in the title sponsor's hospitality tent on the 18th hole.

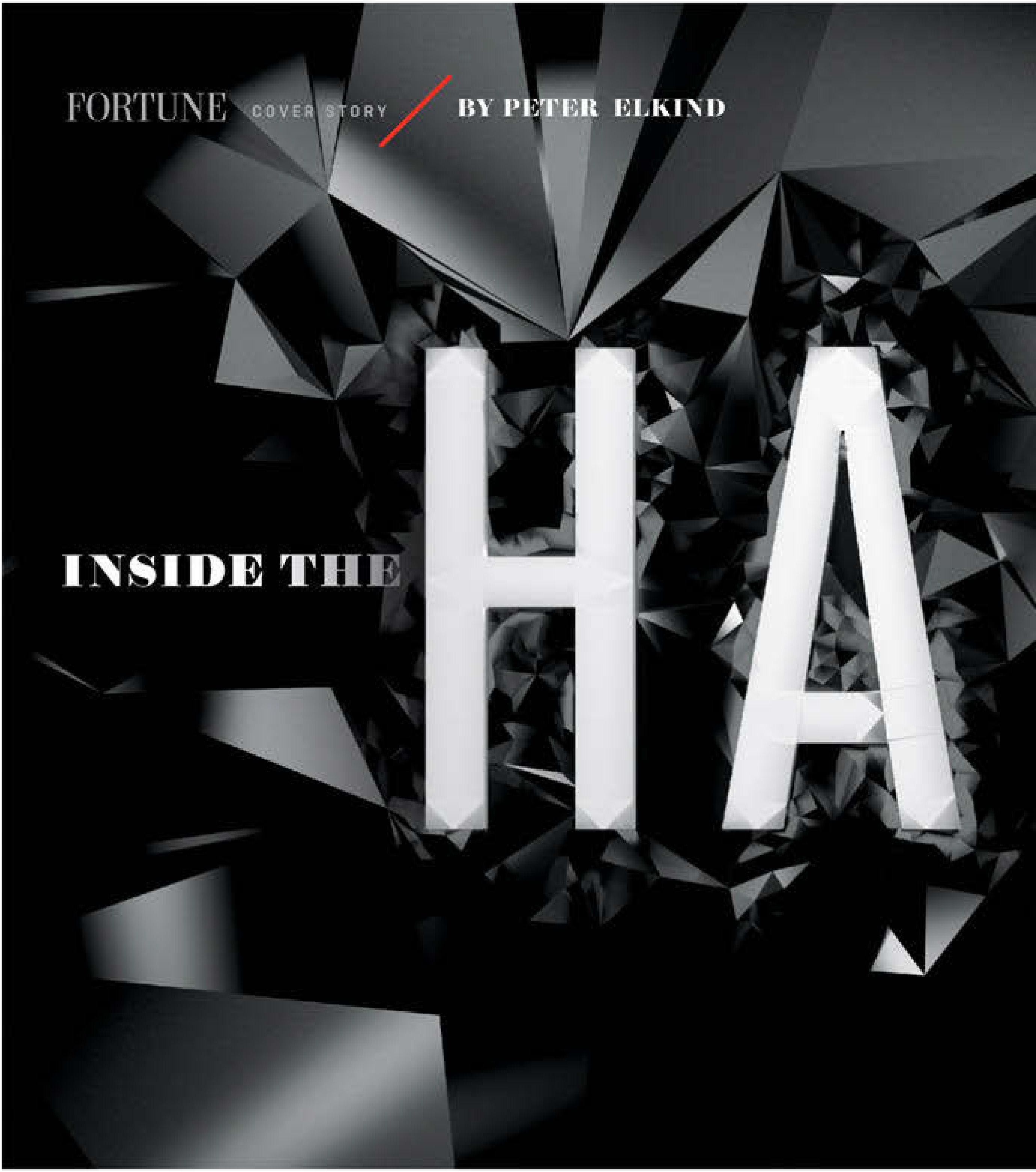
Career and business development should not come at the expense of a healthy lifestyle and work-life balance: This is a key point emphasized by corporate and local Astellas representatives in presentations sprinkled throughout the day as well as through a "healthy balance" survey. It's a subject very well suited to the milieu of professional golf, with its various physical, mental, and emotional demands.

"It's a simple message: 'Your success means nothing without your health,'" says Fiedorowicz. "Astellas is so committed to the health and well-being of women, and this grassroots program provides a unique and authentic way for the company to be in the neighborhoods it serves."

THE PGA TOUR'S EXECUTIVE WOMEN'S DAYS, SPONSORED BY ASTELLAS PHARMA US, FEATURE TALKS BY HIGH-POWERED LOCAL AND NATIONAL BUSINESSWOMEN, AS WELL AS NETWORKING OPPORTUNITIES AND HEALTH INFORMATION.


astellas

BY PETER ELKIND



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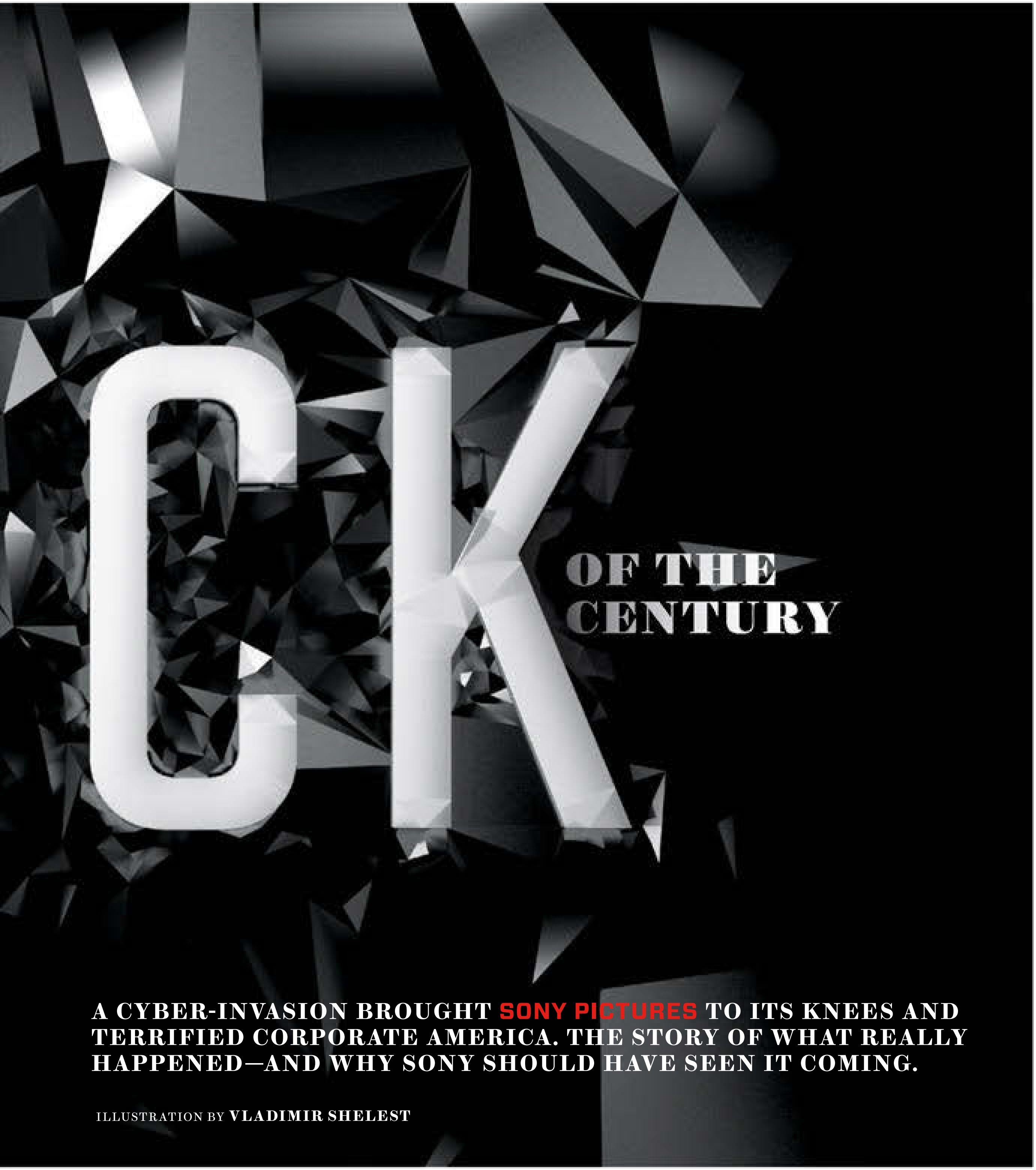


CK OF THE CENTURY

A CYBER-INVASION BROUGHT SONY PICTURES TO ITS KNEES AND TERRIFIED CORPORATE AMERICA. THE STORY OF WHAT REALLY HAPPENED—AND WHY SONY SHOULD HAVE SEEN IT COMING.

ILLUSTRATION BY **VLADIMIR SHELEST**

On Monday, Nov. 3,

2014, a four-man team from Norse Corp., a small "threat-intelligence" firm based in Silicon Valley, arrived early for an 11:30 a.m. meeting on the studio lot of Sony Pictures Entertainment, in the Los Angeles suburb of Culver City. They were scheduled to see Sony's top cybersecurity managers to pitch Norse's services in defending the studio against hackers, who had been plaguing Sony for years.

After a quick security check at the front gate and then proceeding to the George Burns Building on the east side of the Sony lot, the Norse group walked straight into the unlocked first-floor offices of the information security department, marked with a small sign reading INFO SEC. There was no receptionist or security guard to check who they were; in fact, there was no one in sight at all. The room contained cubicles with unattended computers providing access to Sony's international data network.

The visitors found their way to a small sitting area outside the office of Jason Spaltro, Sony's senior vice president for information security, settled in, and waited. Alone. For about 15 minutes.

"I got a little shocked," says Tommy Stiansen, Norse's co-founder and chief technology officer. "Their Info Sec was empty, and all their screens were logged in. Basically the janitor can walk straight into their Info Sec department." Adds Mickey Shapiro, a veteran entertainment attorney who helped set up the meeting and was present that day: "If we were bad guys, we could have done something horrible."

Finally Spaltro, who's worked at Sony since 1998, showed up and led them to a nearby conference room, where another studio information security executive was waiting. The meeting began, and as Stiansen described how Norse scopes out potential threats, Spaltro interrupted: "Boy, that could really help us with that North Korean film!" According to the four Norse representatives, Spaltro explained that he was worried about a Seth Rogen comedy called *The Interview* that the studio was preparing to release on Christmas Day. It featured a plot to assassinate Kim Jong-un, the country's actual leader. Recalls Stiansen: "They said North Korea is threatening them." (Sony denies any mention of a North Korean cyberthreat.)

After about an hour the Sony team declared the session "very productive," according to the Norse team, and promised to be in touch. They departed, leaving the visitors to find their own way out.

THREE WEEKS LATER—starting at about 7 a.m. Pacific time on Monday, Nov. 24—a crushing cyberattack was launched on Sony Pictures. Employees logging on to its network were met with the sound of gunfire, scrolling threats, and the menacing image of a fiery skeleton looming over the tiny zombified heads of the studio's top two executives.

Before Sony's IT staff could pull the plug, the hackers' malware had leaped from machine to machine throughout the lot and across continents, wiping out half of Sony's global network. It erased everything stored on 3,262 of the company's 6,797 personal computers and 837 of its 1,555 servers. To make sure nothing could be recovered, the attackers had even added a little extra poison: a special deleting algorithm that overwrote the data seven different ways. When that was done, the code zapped each computer's startup software, rendering the machines brain-dead.

From the moment the malware was launched—months after the hackers first broke in—it took just one hour to throw Sony Pictures back into the era of the Betamax. The studio was reduced to using fax machines, communicating through posted messages, and paying its 7,000 employees with paper checks.

That was only the beginning of Sony's horror story. Before destroying the company's data, the hackers had stolen it. Over the next three weeks they dumped nine batches of confidential files onto public file-sharing sites: everything from unfinished movie scripts and mortifying emails to salary lists and more than 47,000 Social Security numbers. Five Sony films, four of them unreleased, were leaked to piracy websites for free viewing. Then the hackers threatened a 9/11-style attack against theaters, prompting Sony to abandon *The Interview*'s Christmas release. A week later, after an uproar, the studio announced it would make the movie available, after all, through video on demand and in a few hundred theaters.

On Dec. 19 the FBI blamed the hack on North Korea, which had issued threats over the film. The White House followed with economic sanctions. Sony was pilloried both for horrendous judgment (for making a comedy depicting the killing of North Korea's sovereign leader) and its seeming capitulation (for its initial refusal to show the film). In its darkest hours Sony drew zero support from Hollywood—and a blast from President Obama. Sony's traumatized employees face an ongoing threat of identity theft.

The screen that greeted Sony Pictures employees after they logged on to their computers on Nov. 24. The hack not only stole massive quantities of documents and emails, but it also erased all the data on half the company's computers and servers.

The studio and its Tokyo-based parent, Sony Corp., were already under siege. "Big Sony"—as studio executives refer to it—is facing a prolonged crisis after losing money for six of the past seven years. Sony Pictures remains one of its few moneymaking businesses. But as interviews and internal emails reveal, the studio was a deeply unhappy place, beset by pressures over disappointing profits, cost cutting and layoffs, the scorn of an activist investor, and tribal infighting. Sony Pictures CEO Michael Lynton pursued four separate opportunities to leave the company during the 18 months before the hack.

In Sony's view, the company is a blameless victim. In a December interview with National Public Radio, Lynton insisted his company was "extremely well prepared for conventional cybersecurity," but faced "the worst cyberattack in U.S. history." He has repeatedly described it as a "highly sophisticated attack." Sony Pictures provided written responses to questions through Robert Lawson, its chief spokesman. He says Lynton has no plans to fire or discipline anyone. The CEO's reasoning rests on the belief that because Sony's assailant was a foreign government, with far more resources than a renegade band of hackers, what happened was unstoppable. The studio simply faced an unfair fight.

In a statement, Lawson argues that "any suggestion Sony Pictures Entertainment should have been able to defend itself against this attack is deeply flawed and ignores essential findings and comments made by the FBI and [Sony's cybersecurity consultant] Kevin Mandia—the two parties most knowledgeable of the nation state threat and the evidence in this investigation. Joseph Demarest, then assistant director of the FBI's cyber division, could not have been clearer when he told a U.S. Senate hearing that 'the malware that was used would have slipped, probably would have gotten past 90% of the net defenses that are out there today in private industry, and I would challenge to even say government.'" Mandia, the statement continues, "has also explained how the sophistication of the exfiltration methods used in this attack made them virtually undetectable. And both Mandia and the FBI have stated that the malware used was undetectable by industry standard antivirus software."

In truth, there is no way to know whether Sony's attackers would have prevailed over even impeccable cyberdefenses. Experts say Sony's electronic security probably wasn't worse than that of many others; weak, outmoded practices are the norm at far too many companies. But it's clear that Sony, which failed to employ several basic safeguards, didn't put up much of a fight.

As it was, the company had ample reason to have bolstered its defenses: For years, culminating with its release of *The Interview,* Sony Corp.'s business decisions have made it a virtual piñata for cyberassailants. And North Korea had been blamed for devastating high-profile electronic attacks in the past. Despite that, the company's leadership failed repeatedly to take greater precautions.

"No company is ever going to say, 'We were just sloppy, so people got in,'" says cybersecurity expert James Lewis, senior fellow at the Center for Strategic and International Studies. "The fact that it's a nation-state and is hard to defeat doesn't mean you have to leave the doors wide open and put out the welcome mat."

This article is based on more than 50 interviews with current and former high-level executives at Sony (all of whom insisted on not being identified by name), cybersecurity experts, and law-enforcement officials. It is also based, in large part, on Sony emails and documents stolen by the hackers. Beyond generating Hollywood gossip, which they already have, they offer a remarkable window into the business of Sony Pictures at the time of the hack: the personalities of its leaders, the pressures they faced in their relationship with the business's Tokyo-based parent, and the challenges of running an entertainment studio in the 21st century. (We've preserved the emails' original punctuation and often sloppy spelling.)

The emails also reveal myriad surprises and previously unreported anecdotes, including one episode in which Sony spied on its own employees' emails. Paradoxically, the hacked emails and documents provide a telling window into how and why such a disastrous hack succeeded and what companies need to do to protect themselves—which is precisely why *Fortune* has chosen to use this material. (For more on our thinking, see Editor's Desk in this issue.)

What happened at Sony stands as a landmark event. It struck terror in boardrooms throughout corporate America, and for all the unique elements in Sony's situation, the lessons apply to every company. After all, to use an old line, there are only two kinds of companies: Those that have been hacked, and those that don't yet realize they've been hacked. Countless behemoths have been victimized on a massive scale, including Target, Anthem, Home Depot, and J.P. Morgan, suffering incursions for profit-oriented data theft or corporate espionage.

The peril for corporate America seems to be growing even faster than the immense resources now mobilized to combat electronic crime. (The government has hardly been immune, with high-profile infiltrations of the IRS, the White House's email system, and the U.S. Office of Personnel Management.) But for the most part, previous corporate invasions have afflicted customers, not businesses. This one hit home because it showed how attackers could steal even executives' most precious secrets—and bring a company to its knees.

Sony Pictures CEO MICHAEL LYNTON and studio chief AMY PASCAL, photographed on Sony's lot in 2010, were emotional opposites but collaborated productively for a decade.

ROBERT GALLAGHER—CORBIS OUTLINE

The Humbled Giant

THE IMPROBABLE COMBINATION of a Japanese electronics giant and a Hollywood studio dates back to 1989. Sony Corp. was then the most dominant electronics company on the face of the earth, at a moment when Japanese business dominance seemed permanent. Sony paid an eye-popping $4.8 billion for struggling Columbia Pictures, declaring movies the equivalent of "software" needed to boost sales of its premium "hardware"—TVs, videocassette recorders, and music players. The studio was renamed Sony Pictures Entertainment but continued to struggle, forcing a $2.7 billion write-down five years later.

The next quarter-century was not kind to Sony Corp., which clung to its consumer electronics business as it became commoditized. Today the company remains a Goliath, with 132,000 employees and $74.7 billion in revenues for the fiscal year ending in March. But Sony has lost $12.1 billion over the past seven fiscal years. When Kazuo Hirai became CEO in April 2012, he declared "a very severe sense of crisis" and announced a turnaround strategy, including thousands of layoffs. In the change-averse Japanese corporate culture, it has unfolded far too slowly.

Hirai, who succeeded Howard Stringer, Sony's first non-Japanese CEO and a man frustrated by his inability to reenergize the sclerotic company, rose through its PlayStation videogames division, which he helped make a reliable moneymaker. Just 51 when named CEO, Hirai dressed casually, encouraged employees to call him Kaz, and, after years in the U.S., pitched products in perfect English.

Like his predecessors, Hirai kept his hands off Sony Pictures, run for more than a decade through a delicate yin-yang partnership. Sony's studio chief was Amy Pascal, who reigned as the most powerful woman in Hollywood. Masterly at stroking celebrity egos, Pascal cultivated relationships with filmmakers and stars, who returned the affection. "I adore you, Amy," George Clooney wrote her last year. "You are literally the only person running a studio that loves film." Raised middle class in Los Angeles, Pascal was frenetic, thin-skinned, and unfiltered, given to long, stream-of-consciousness emails. Paid $9.1 million


COLUMBIA
BURL

for 2014, she proudly presided over her domain from a majestic office once occupied by Louis B. Mayer. She had a reputation for dispensing overly generous deals and falling in love with ambitious movies that had dubious commercial prospects.

To inject fiscal discipline, Stringer in 2004 had forced Pascal to team up with Lynton, who had left a job as head of AOL Europe to join Sony Pictures as CEO. Raised in the Netherlands by a wealthy German-Jewish family that fled Hitler, Lynton attended Exeter before earning his undergraduate degree and MBA at Harvard, where he played rugby; he'd done a stint as an investment banker. Cool, cerebral, and measured, Lynton was an East Coast intellectual with artistic interests that he viewed as more refined than the crassly commercial fare typically peddled by Hollywood. In 1998, after leaving Disney Studios and moving back east to run Penguin Books, he told a *New Yorker* writer of his "horror" at "living in a town where everything is about movies."

A consummate networker, Lynton avoided drama and the spotlight, preferring to pull strings behind the scenes. He arranged a film audition for billionaire Leon Black's actress-niece, dined with President Obama on Martha's Vineyard, and plotted with Facebook COO Sheryl Sandberg to see if they could find a blind date for Malcolm Gladwell, one of his many writer buddies.

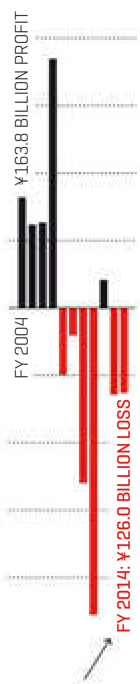
Despite his personal wealth (which included 2013 Sony pay of $9.6 million), Lynton made a show of being frugal. He drove a Volkswagen Golf GTI. Pascal described him in one leaked email as "the kind of guy who wears the same pair of shoes every day but what you wouldn't know is that they were made by the poshest most expensive cobbler in switzerland."

Lynton and Pascal had survived together for a decade—an eternity in Hollywood. Both in their mid-fifties, they lived two miles apart and even attended the same synagogue. When Lynton first took the job, he diplomatically vowed to steer clear of Pascal's turf and rarely stood in the way of a film she wanted—even one he loathed—where the bottom line seemed to make sense. After reading the script for a movie called *Money Monster,* for example, he wrote Pascal: "I hate it…It is simplistic, bombastic, wrongheaded, and stupid. All that being said…if the numbers work and there is no risk then I am ok." Sony moved forward with the film; its release date is undetermined. (Says Sony spokesperson Lawson: "Initially [Lynton] was not supportive, but what you don't see in the stolen emails is that through further discussion, his position changed and he ended up supporting the project.")

Hirai maintained a similar posture. In June 2014, after forwarding enthusiastic European screening reports for the Cameron Diaz comedy *Sex Tape* (which would later bomb), Lynton joked with the Sony Corp. CEO about their mutual dislike for it. "Something tells me that I should keep my day job," wrote Hirai.

"The box office will be the judge," Lynton replied. "But you and I have the same view of the movie!!"

SONY CORP.'S LOSS YEARS



MOST RECENT FISCAL YEAR: $1.0 BILLION LOSS

CHART SOURCE: S&P CAPITAL IQ

Fending off Dan Loeb: "No cost is too sacred to cut."

IN MAY 2013 a new consideration altered "Big Sony's" dealings with the studio and shook its fragile management partnership: The parent company came under pressure from Dan Loeb. Loeb, who runs the New York City–based hedge fund Third Point, had acquired a $1.1 billion stake in Sony Corp.—more than 6% of its Tokyo shares—and placed Sony Pictures in his crosshairs.

Loeb is rough on his targets, often accusing executives of personal misconduct in an attempt to drive them out. In a letter he urged Sony Corp.'s board to spin off up to 20% of the studio (as well as its music business, which Lynton also oversees) through a public offering to help fund its turnaround. Loeb publicly charged that Sony Pictures was "famously bloated" and "poorly managed," with profit margins far below those of rival studios. Hirai, he asserted, was giving Lynton and Pascal "free passes."

The movie business is volatile. But in truth the studio was not only experiencing a bad run but also poorly positioned for the future. Its two pricey would-be summer blockbusters for 2013, *White House Down* and *After Earth,* flopped. Sony's pipeline was short on "tentpoles," the big franchises that generate lucrative sequels and tie-in products, such as action figures and videogames. The studio produced few animated hits for the family market. And too many of its movies had limited appeal overseas, now two-thirds of total box-office receipts.

Still, Hirai had no intention of doing what Loeb wanted. Despite its problems, the movie studio, with about 11% of the parent's revenues, remained one of Sony Corp.'s few profitable realms. A spin-off would also undermine Hirai's "One Sony" strategy—his re-

vived notion of the old software-hardware synergy.

What followed was a strange form of misdirection. Although many at Sony feared and loathed Loeb (an executive vice president, in a leaked email, called him a "douchebag"), the company's chiefs launched a public charm offensive in hopes of persuading him to walk away. Hirai had breakfast with Loeb in Tokyo. Lynton and Pascal hired a new $600,000-a-year studio PR chief, Charlie Sipkins, from a crisis-management firm where he'd helped Yahoo deal with Loeb successfully. And Sony announced it was responding to Loeb's calls for increased transparency with its first-ever "Entertainment Investor Day," to be held on Nov. 21, 2013.

Executives prepared for this event, which was to be webcast, as if it were Oscar night. Pascal drafted her presentation three weeks early, then emailed Lynton and others: "LET'S START REHEARSING NOW." When Loeb, during a CNBC interview, expressed pleasure with promised Sony actions, company executives tweaked their scripts to highlight those steps. PR man Sipkins even sent everyone an email on preferred attire: "We want to project a consistent image ... men should wear dark suits, nonpatterned shirts, and simple ties. If possible, women should wear suits or long skirts/dresses."

In five hours of presentations Sony executives labored to display their commitment to fiscal discipline and consistent earnings. Lynton and Pascal promised tighter policies for green-lighting films. Talent would get less generous deals, more dependent on financial results. Sony was reducing its annual slate from two dozen movies to 18. And the studio vowed to slash $250 million in expenses over the next two years, a process that would result in hundreds of layoffs. "No cost is too sacred to cut," Lynton declared.

By then Lynton had hired management consultants Bain & Co. to find at least another $50 million in cuts, for a total of $300 million. Sony labored to "spin" this bloodletting, privately instructing the executive team, according to hacked meeting minutes: "Going forward, everyone should use the name 'Build for Tomorrow' when referring to the project ... the process can be enormously productive, and we need everyone to embrace it wholeheartedly." But Bain's hiring leaked into the press before Sony even announced it internally. This, TV chief Steve Mosko complained to Sony's CFO, had generated "a major shit storm ... I had people in my office all day yesterday asking if they were losing their job."

DAN LOEB

PHIL MCCARTEN—REUTERS

SONY PICTURES WAS "FAMOUSLY BLOATED" AND "POORLY MANAGED," THIRD POINT'S LOEB SAID AFTER TAKING A STAKE IN SONY CORP. THE INVESTOR'S AGITATION CAUSED FEAR AND LOATHING INSIDE THE STUDIO. ONE EXEC REFERRED TO LOEB AS A "DOUCHEBAG."

Yet it appeared to have the desired effect on Loeb. In January 2014 he emailed Hirai and Lynton that he'd fed friendly comments about the company to the *New York Post*. "Hope they were helpful," he said. When *Variety* called him for a story, Loeb gave Sony executives a heads-up. "I'm talking on background only," he confided. (Loeb declined to speak with *Fortune*.)

Still, Nicole Seligman, Sony Corp.'s New York–based general counsel was wary, according to leaked emails. Was a mole inside Sony talking to Loeb? She decided to find out. At her direction the studio's top lawyer, Leah Weil, secretly arranged for the IT department to unearth all email traffic between Loeb and anyone at Sony since January 2013, then forwarded the messages to Seligman. The search turned up just a dozen innocuous exchanges between Loeb and two Sony executives, Lynton and Mosko, who had already told Seligman about them.

"Nothing new," Seligman wrote Weil in a confidential email. "Should not be shared beyond you."

"Understood," Weil replied.

"Why is everyone freaking out ... what is the big deal?"

THE FALLOUT from Loeb's campaign caused widespread unhappiness at Sony Pictures. At Investor Day, with flat profits projected for the movie business, Lynton promised "a significant shift in emphasis" to the studio's real moneymaker: television. Driven by hits like *Breaking Bad* and *Blacklist*, syndication, and a growing portfolio of overseas channels, TV was already producing more than half the studio's operating profit. Sony was projecting that figure to climb to 75% by 2018.

Pascal was beside herself at the resulting coverage in the trade press, according to leaked emails: that TV was now paramount, that her job was in jeopardy, and—in a *Hollywood Reporter* story—that she had only recently parted ways with a personal assistant paid "well over" $250,000 a year. (Actually, it was $300,000.) "This is truely the most ridiculous inaccurate article I have ever read" ... "absurd" ... "so stupid" ... "insane," she vented in a series of emails to Sony executives, industry friends, and family. "I dont get whats going on," she wrote Lynton. "Why is everyone freaking out ... what is the big deal?"

"Because we said no cost is too small," shot back Lynton. "An assistant paid that amount suggests a lack of controls. We claim to have those controls."

"Michael all the stories are about how we are concentraing on tv and how you have ultimate greenlight authoruty ... it was two fucking movies ... how long does this go on?"

"Until we can show a real turn around or they focus on the next studio," Lynton replied.

The executives running television, who reported to Pascal, also felt maligned. Mosko, a yoga-practicing fitness buff who had been at Sony for two decades and rebuilt its TV business, accused Pascal and Lynton of supporting a "personal attack" in the media on him and his group. In a February email to Pascal, he wrote, "I've always delivered for you guys ... and getting thrown under the bus and treated like the help ... it's fucked up." Mosko vented to Lynton, too, after the CEO scolded him about startup costs for new shows. "I feel a ton of hostility coming my way and I'm not sure why ... every year we find a way to deliver ... and then some ..."

In late summer Lynton even came to suspect the TV chief was attempting a power play. "Steve Mosko is actively campaigning to be made COO of SPE," he advised Seligman, then vacationing in Prague. "Steve/COO? Oy," she replied.

Lynton, facing growing pressure to boost profits, wasn't happy either. "Work has been very taxing lately," he confided to a friend in November 2013. "All a bit more than I signed up for, but I will persist ..."

After a decade as CEO and uncertain of his future after the departure of Stringer (who had hired him), Lynton had already begun exploring opportunities to leave. In early 2013 he had two conversations with Time Warner CEO Jeff Bewkes about running the Warner Bros. studio. Then, in October 2013, Ilene Nagel, a Russell Reynolds headhunter advising Tulane University on its search for a new president, contacted Lynton about the job. Although Lynton lacked a Ph.D. and had never been an academic, he agreed to fly to New Orleans to meet with the search committee. Before that could happen, Nagel informed Lynton that Tulane had canceled after deciding that his lack of traditional credentials would make it a "challenge for you to gain acceptance."

By then Lynton was pursuing a third position: as secretary of the Smithsonian Institution, its top management job. Lynton met with Smithsonian board members on Jan. 8, and Nagel emailed him a "hugely confidential smiley" the next day.

"Wow. Great news!" Lynton replied.

INSIDE THE HACK OF THE CENTURY

"Mum's the word," she advised.

Once again, though, it didn't work out. In February he got word from Nagel that the board had "opted for the more traditional candidate."

In his most concerted effort to leave, Lynton spent more than a year pursuing the presidency of New York University, being vacated in 2016, when Lynton's Sony contract was up. In November 2013, after a meeting with John Paulson, a hedge fund billionaire on the NYU board, Lynton agreed to submit a letter promoting his candidacy. With editing suggestions from relatives and friends—including *New Yorker* writer Gladwell—he drafted a three-page pitch in December. "While I may not at first glance be a logical candidate to be the next president of NYU, I think that on closer inspection my qualifications for

▲ Sony Corp. CEO KAZUO HIRAI (above left) tried to shake the company from its "crisis." Inset: Hirai, then overseeing Sony's PlayStation business, bowing in apology in 2011 after a damaging hack.

ETHAN MILLER—GETTY IMAGES; INSET: SHIZUO KAMBAYASHI—AP

the position are excellent..." Lynton wrote. He touted his experience "managing disruptive, egotistical, and difficult personalities who are very talented, driven, innovative, and stubborn. It is not that very different from the academic environment of a university."

Lynton would continue to campaign for the position during 2014. In August he met with attorney Marty Lipton, NYU's board chairman, who bluntly advised him that he was a "long shot." Lynton didn't take the hint, telling Lipton he would still "very much like to put my name forward for the position." In September, Lynton met with billionaire Ken Langone, another member of the search committee.

Meanwhile the pressures at Sony Pictures intensified. Sony was counting on big box-office numbers from the latest installment of *Spider-Man*, its biggest franchise, whose previous four films had grossed a combined $3.25 billion. (Lynton invited Loeb to the New York premiere but instructed his staff to make sure that the investor's seats be "nowhere near Amy or me.") But at $709 million in worldwide ticket sales, *Amazing Spider-Man 2* disappointed; Sony had projected $865 million. An outright flop came two months later, with the comedy *Sex Tape*. "I think it kills the year," Lynton emailed Pascal, as the depressing results arrived. "We keep putting our heads in the sand. I fear that this may just be one too many."

"Totally floored by this movie. And by you."

EVEN AS SONY'S film business struggled through another rocky year, Pascal hoped her skill at building relationships with emerging stars would help turn things around. Seth Rogen was perhaps her favorite.

Rogen and his collaborator Evan Goldberg had been making profitable movies with Sony since 2007, starting with *Superbad*, which they had written as teenagers in Canada. The pair's hits included *Pineapple Express* and *This Is the End*. By early 2014, Pascal was working to line up Rogen for three more Sony projects. *The Interview*, which Rogen and Goldberg had directed and already filmed, was set for wide release on Oct. 10, 2014.

Rogen didn't always plan a comedy about a plot to kill the actual ruler of North Korea. Early scripts employed a fictional character named Kim Il-hwan, according to *Interview* screenwriter Dan Sterling. He maintains it was a studio executive (he declined to give the person's name) who originally suggested using Kim. Rogen and Goldberg loved the idea. Unlike, say, China, an important film market and thus one Sony didn't want to alienate, North Korea was regarded as fair game for provocative material in Hollywood. Pascal and Lynton blessed this change.

In hindsight it's easy to second-guess this decision. North Korea is a rogue state (with nuclear missiles) led by a volatile, unpredictable dictator. "Why is it necessary to name Kim Jong-un?" a filmmaker who has worked with Sony asks *Fortune*. "Is it going to mean that much more at the box office? If you're doing a serious film it's one thing. But it's a fart movie!"

The plot of *The Interview* is now well known. A doltish tabloid talk-show host played by James Franco and his bosom-buddy producer (Rogen)

are invited to North Korea to interview Kim Jong-un, who's a secret fan of their program. The CIA then enlists the pair to assassinate Kim. Some laughs ensue. It all ends with Kim's fiery death in a helicopter, which Franco's and Rogen's characters gun down from a commandeered tank.

The Interview cost $44 million to make ($8.2 million went to Rogen) and had a $32 million marketing budget. Sony had hefty box-office expectations for the R-rated comedy: $100 million to $135 million. The movie featured tigers, military hardware, and expensive special effects. Even Rogen marveled at the latitude he'd enjoyed, telling *Rolling Stone* before its release, "They're giving us insane amounts of money to do whatever the fuck we want."

Given the pair's commercial success, Sony was deeply motivated to keep Rogen and Goldberg happy and on the studio lot, where they worked out of a suite of offices and strolled the grounds smoking weed. "We love your movies and frankly yours is the most important relationship we have," Dwight Caines, Sony's president of theatrical marketing, told Rogen in an email. Test screenings for *The Interview* were strong. "Totally floored by this movie. And by you," Pascal wrote Rogen and his team in April. "Thanks for letting us make it," Rogen replied. "Nobody else would do that."

Rogen and his collaborators seem to have genuinely wanted to make a statement about the loony and oppressive ways of the Kim regime. "I was thrilled by the opportunity to make a mass appeal studio movie with a bit of political commentary in between the dick jokes," says Sterling. Sony executives seemed onboard. "The movie is doing something bold that I'm not sure any other movie has done before—taking on as its subject matter a real persona of this notoriety," Caines wrote Rogen in May. "This is the kind of angle that makes this notable ... fun with a dash of smarts."

We will take "a merciless counter-measure."

ON JUNE 17, leaked emails show, Sony's appetite for mocking a "real persona" instantly diminished. Days after the film's first trailer appeared online, Hirai, who had just screened the movie, called Lynton, concerned about roiling already fraught relations between Japan and North Korea. As Hirai saw it, this made *The Interview* dangerous fare for a Japanese company.

From left: actor JAMES FRANCO, co-director EVAN GOLDBERG, and co-director and actor SETH ROGEN on the set of *The Interview*

ROGEN ON SET AND *THE INTERVIEW* STILL: ED ARAQUEL—COLUMBIA PICTURES/COURTESY OF EVERETT COLLECTION

Lynton scrambled, first by yanking the trailer from the Internet for re-editing. As part of Hirai's One Sony initiative, the studio had just added the Sony logo to the credits for all films released under the studio's brands, which include Columbia Pictures, TriStar, and Screen Gems. Now orders went out to erase "Sony" from everything associated with *The Interview* in an attempt to downplay its Japanese parentage. Plans for a limited Asia release were also scrapped. "Have to keep whole interview thing under wraps," Lynton told Pascal.

That wouldn't be easy. Within days a North Korean government spokesman warned that *The Interview*'s release would represent "the most blatant act of terrorism and war," and threatened "a merciless counter-measure." (The government later filed formal complaints with the White House and the United Nations Security Council.) North Korea has long been known for its threats against other countries, but most have turned out to be mere bluster.

Still, the Kim regime had been widely blamed for a series of cyberattacks, especially against its archenemy, South Korea, and was believed to employ a

From top: a scene from *The Interview,* with the movie's Kim Jong-un at right; the scene outside one theater in Los Angeles on opening night, Dec. 25, 2014

THEATER: JUSTIN BAKER—WIREIMAGE/GETTY IMAGES

cadre of several thousand army hackers. The worst incident had occurred in March 2013. Known as the DarkSeoul attack, it caused $700 million in damage to South Korean banks and broadcasters, freezing ATMs and erasing the hard drives of 30,000 computers. The hackers in this episode, which received considerable press coverage in the U.S., posted a notice featuring images of skulls.

Yet Sony Pictures executives were caught off guard by the growing storm over their film. They tried to assess the danger. Reached in Europe after Hirai's call, studio executive Doug Belgrad advised Lynton that he was now "doing the homework on whether there is precedent on depicting and/or killing a living leader on film." Emails show Lynton tapped his personal network, conferring informally with two outside experts. (Rogen brushed it all off with a jocular tweet: "People don't usually wanna kill me for one of my movies until after they've paid 12 bucks for it.")

In a written statement on behalf of Lynton, Sony spokesman Lawson insists that the "extremely knowledgeable" experts the CEO consulted "gave no hint or warning of the possibility of a cyberattack." Indeed, one expert Lynton spoke with, Daniel Russel, assistant secretary of state for East Asian and Pacific affairs, made no mention of hacking risk, according to a note Lynton prepared memorializing their conversation.

But Lynton got a different message from the expert he consulted most extensively. Bruce Bennett, a North Korea specialist with the Rand Corp.—where Lynton serves on the board—says he did warn the Sony CEO that a cyberattack was "a possibility."

After watching *The Interview*, Bennett sent him a three-page memo assessing the situation even before the Koreans began protesting the film, then had several follow-up exchanges with Lynton. Bennett advised him that the North Koreans frequently made empty threats, and there probably wasn't much to fear.

Bennett's memo noted the likelihood that North Korea would probe Sony's computer systems: "Even if North Korea doesn't know about the film yet, as soon as they do find out about it, they will likely explore Sony's computer systems to see if Sony is ready to deal with North Korean criticism." (The memo was not retrievable from the hacked documents; Bennett read the passage to *Fortune*.)

[redacted]

[redacted]

In their follow-up conversations, Bennett says, he went further. He says he told the CEO that the Kim regime employed hackers "who could potentially cause damage," described the DarkSeoul episode, and counseled: "You need to realize something could happen in that area." Lawson denies this: "If [Lynton] had received any kind of warning, his next call would have been to a cyberexpert to ask about it ... In their many phone conversations, Bennett never mentioned the possibility of a cyberattack on the studio ... ")

Rogen and Goldberg also received warnings of a possible cyberattack, according to their spokesman, Matt Labov. Even before they began shooting the film the pair sought the advice of Rich Klein, whose Washington, D.C.–based consulting firm, McLarty, advises Hollywood on sticky geopolitical problems. After reading their script, Klein tells *Fortune*, he advised the filmmakers to expect North Korean "blowback," possibly in the form of an electronic assault. He urged them to change their banking and email passwords and closely monitor their Internet accounts, and passed on the name of a cybersecurity adviser.

Klein says he also feared that North Korea might unleash a cyberassault on the studio to try to block *The Interview*'s release. Rogen and Goldberg relayed that message to Sony executives, according to Labov. "We felt that everybody involved in this had to protect themselves—the studio and the filmmakers," says Klein. "The North Koreans are pretty aggressive cyberwarriors ... It's just surprising to me that there wasn't a more robust sense of alarm and caution." (Sony's spokesman also denies receiving a warning from Rogen and Goldberg.)

Instead of hardening its network defenses, emails show, Sony focused on somehow trying to offend the North Koreans less. Their actions befit a Hollywood farce. Never mind that Sony was planning to release a film that portrayed the violent death of a real head of state; the company spent \$550,000 to digitally alter the movie's images of Kim family members shown on a wall mural and jacket pins worn by movie characters. It banished marketing materials for *The Interview* from Sony websites. And the studio prepared a statement insisting the movie was "a fictionalized comedy that is not in any way related to current events."

In early August, Pascal departed with her family for a long vacation through Asia. Lynton decamped to Martha's Vineyard. By then they'd decided to postpone *The Interview*'s release until Christmas Day, buying time to tackle another issue. On Hirai's orders, studio executives had begun a three-month battle with the filmmakers to soften the movie's gory climactic scene, in which a tank shell strikes Kim's helicopter and kills him in a slow-motion, head-popping, flesh-dripping ball of fire.

The *Hollywood Reporter* caught wind of this, Sony Pictures PR executive Jean Guerin advised Pascal and other executives in an email. It was preparing to report that "Corporate Sony" had asked for "a few key edits," including "that the melted face of Kim Jong-un will now be taken out of the final cut ... " The studio denied that changes were being made in response to outside pressure. "We are dismissing [the reporter's] premise and letting her know off the record that this is normal/what happens in the filmmaking process," Guerin told the executives.

The article, which appeared on Aug. 13, suggested that Sony was changing the movie to appease the North Koreans. Rogen was livid. As he saw it, this painted him as a sellout. Executives convened an emergency call to plan damage control. Asked to join the session, Lynton said he was at a dinner on Martha's Vineyard and couldn't get up to leave. "I am sitting between president obama and Hillary Clinton ... If we need a change of strategy then I don't want anything done until we speak."

Hirai and Lynton, who found the movie more offensive than funny, wanted the "head-popping scene" eliminated entirely. "We cannot be cute here," Lynton wrote in one email. "What we really want is no melting face and actually not seeing him die." But Rogen was fiercely resisting major changes in what he called the "awesome" shot.

Sony had final authority over the editing of the movie. But according to interviews and leaked emails, the studio feared that if it imposed its will, Rogen would disassociate himself from the film, creating a box-office and PR debacle. "This movie is supposed to be controversial," he emailed Pascal. "That was your pitch to us amy. There's nothing controversial about a movie that has been tempered to appease the very people it's mocking." (Rogen barraged Pascal, then vacationing through Vietnam and Bali, with messages, insisting they talk "as soon as humanly possible." Pascal forwarded one email to a colleague, asking, "Can I be lost in the jungle?")

On Sept. 25, Pascal, back in L.A. and sitting in tem-

ple on the Jewish New Year holiday, emailed Rogen an emotional personal plea to make the scene "a little less gory." "No one has backed you more than I have," she wrote. "And this isn't some flunky it's the chairman of the entire sony corporation who I am dealing with. You must know there are very few relationships and film makers I would let myself be in this situation for."

Rogen relented, agreeing to reduce Kim's "flaming hair by 50%," cut "three out of four of the face embers," and alter "the color of the head chunks to try to make them less gross." On Sept. 28, after viewing the new version, Hirai gave his blessing, according to emails, with the understanding that the scene would be removed entirely from any overseas release. Plans to release and promote *The Interview* moved forward. "I would love working for you and Sony no matter what you decided," Pascal emailed Hirai, "but I just needed to tell you how important this was for me and the studio Thank you for being an amazing leader and a very cool boss With much gratitude and devotion Amy."

"From a single injection, we accessed EVERYTHING."

LOOKING BACK, it's hard to understand how Sony Pictures could have been so ill-prepared for an electronic invasion. It was part of a tech company that sells digital products—films, TV shows, videogames, and music—readily subject to online theft. Angered by Sony Corp.'s heavy-handed tactics to protect intellectual property, hackers have long targeted the company's various divisions. Says cybersecurity guru Bruce Schneier, a fellow at Harvard's Berkman Center for Internet and Society: "Sony is a company that hackers have loved to hate for 10 years."

This dates back to the "rootkit scandal" of 2005, when Sony's music division, seeking to combat piracy, manufactured millions of CDs that surreptitiously installed software on users' computers that blocked illegal copying—but also spied on their listening habits, slowed their PCs, and created security vulnerabilities. After a tech blogger exposed this, Sony faced state attorneys-general lawsuits, class-action cases, and Federal Trade Commission charges (later settled). The episode outraged consumers—especially privacy-sensitive hackers—who urged a boycott of Sony products.

In the years that followed, the antagonism only grew. In 2011, Sony launched what became known as its "war on hackers." Citing copyright and computer fraud laws, the company sued a celebrated 21-year-old hacker named George Hotz (a.k.a. "geohot") for "jailbreaking" his PlayStation 3 console so it could run pirated games and free software, then posting a video showing how to do it. Sony even subpoenaed server logs showing who had visited Hotz's website. The company sued a second hacker in Germany; police raided his home and seized his computers.

Blowback swiftly followed. In April hackers, declaring this crackdown "wholly unforgiveable," breached Sony's PlayStation Network and exposed personal information for 77 million customers and credit card records for 10 million of them. The episode forced Sony to shut down its network for 24 days and cost it $171 million. In congressional testimony, Tim Schaaff, the chief of Sony's PlayStation Network, used language that was strikingly similar to what Sony Pictures would employ years later: The company, he insisted, had fallen victim to a "highly sophisticated" breach, "unprecedented in its size and scope," despite "very, very strong" security.

Outside experts disagreed. They concluded that shoddy IT practices, including a failure to install software security updates, left Sony wide open. British regulators later fined the company the equivalent of $396,100 for failing to protect private information, saying the breach "could have been prevented" and calling Sony's security measures "simply not good enough." The company blamed the episode on Anonymous, but the group—which has taken responsibility for other hacks—insisted it had been framed; the guilty party was never determined.

Before 2011 was out, various Sony businesses suffered 20 more breaches, making a mockery of the company's claims of strong defenses. Sony Pictures fell victim in June, when LulzSec, an Anonymous splinter group, broke into its network using a simple technique and revealed personal information for some customers. LulzSec boasted that it had obtained information on a million Sony customers and had invaded just to show how easy it was: "From a single injection, we accessed EVERYTHING. Why do you put such faith in a company that allows itself to become open to these simple attacks?" Sony's defenses were viewed as so pitiful by Internet bloggers that they inspired a derisive term: "Sownage," as in "being totally owned like Sony."

SETH ROGEN

"THERE'S NOTHING CONTROVERSIAL ABOUT A MOVIE THAT HAS BEEN TEMPERED TO APPEASE THE VERY PEOPLE IT'S MOCKING," ROGEN WROTE AS HE RESISTED CHANGING *THE INTERVIEW.*

MICHAEL TRAN—FILMMAGIC/GETTY IMAGES

In the aftermath of the PlayStation attack, Kaz Hirai, then presiding over Sony's gaming and consumer products businesses, formally bowed in apology at a Tokyo press conference. He vowed new measures to toughen cyberdefenses across the company. In September 2011, Sony Corp. also announced the hiring of its first global chief information security officer, former Department of Homeland Security cybersecurity czar Philip Reitinger.

"I will not invest $10 million to avoid a possible $1 million loss."

IT'S NOT KNOWN precisely what new safeguards Sony Pictures implemented in the wake of Hirai's promises; the company declined to provide examples. But it's painfully clear whatever steps it took weren't enough.

The studio's email system, for example, didn't employ a fundamental protection called two-factor authentication, which many companies have used for years. This requires anyone logging in to use two forms of identification—for example, a personal password and a one-time password randomly generated on a mobile phone or electronic key-chain fob—making it far harder for hackers to steal a user's identity.

Lax email practices weren't new at Sony. In a 2007 article titled "Your Guide to Good-Enough Compliance" in *CIO*, a trade publication for IT professionals, studio cybersecurity chief Spaltro told the writer how an auditor, citing Sarbanes-Oxley requirements to protect personal info, had warned him that Sony had multiple security weaknesses, including lax password procedures. "If you were a bank, you'd be out of business," the auditor told him. Spaltro talked the auditor out of noting the deficiency, according to *CIO*'s phrasing, by arguing "that if his people had to remember those non-intuitive passwords, they'd most likely write them down on sticky notes and post them on their monitors. And how secure would that be?"

Spaltro seemed more afraid of the costs than the risks. "We literally could go broke trying to cover for everything," he told *CIO*. "I will not invest $10 million to avoid a possible $1 million loss," he reasoned. "It's a valid business decision to accept the risk." Although Spaltro's statements were made eight years ago, before Sony became the prominent repeat target of hackers (and he insisted "Sony is over-compliant in many areas"), there's little sign the company's attitude changed.

Pascal was known for her close relationship with actors, producers, writers, and others. "I adore you, Amy," wrote GEORGE CLOONEY. "You are literally the only person running a studio that loves film."

CLOONEY, SMITH, MAGUIRE, WITHERSPOON, AND DAMON: KEVIN WINTER—GETTY IMAGES

There was a litany of laxity. Sony's email-retention policy left up to seven years of old messages on servers, unencrypted and ripe for the taking. The company was essentially using email for long-term storage of business records, contracts, and documents saved in case of litigation. When Sony announced plans, in the fall of 2014, to reduce how long emails would be stored to two years—to make the system run better, according to emails, not because of hacking risk—howls of protest erupted at the studio.

An array of sensitive information—including user names and passwords for IT administrators—was kept in unprotected spreadsheets and Word files with names like "Computer Passwords." Sony's IT team had difficulty keeping track of all the hardware in its network, which included 30 data centers. In the fall of 2013, while transferring studio security monitoring from an outside vendor to a corporate Sony team, one firewall and 148 routers, switches, and web servers

Pascal with (clockwise from top left) actors WILL SMITH, JENNIFER ANISTON, and ADAM SANDLER, producer SCOTT RUDIN, agent BRYAN LOURD, actors MATT DAMON, REESE WITHERSPOON, BRAD PITT, and (center) TOBEY MAGUIRE

ANISTON AND SANDLER: CHRISTOPHER POLK—GETTY IMAGES; PITT: LESTER COHEN—WIREIMAGE; RUDIN: JEAN BAPTISTE LACROIX—WIREIMAGE/GETTY IMAGES; LOURD: ARAYA DIAZ—GETTY IMAGES

were left unwatched for months, according to a September 2014 PricewaterhouseCoopers audit included among the hacked documents. "As a result, security incidents impacting these network or infrastructure devices may not be detected or resolved timely," the report noted. Over a 10-month period, according to the audit, the corporate team had alerted the studio to 193 security "incidents."

In August 2014, Reitinger, the executive who had been hired to harden Sony Corp.'s defenses, quit as global chief information security officer. A Sony spokesperson says his departure was "long planned and not a surprise." Emails at the time paint a different picture. "Was this a surprise?" Sony Pictures general counsel Weil wrote security chief Spaltro. "Yes," he replied.

Reitinger, an advocate for stronger security during his time in government, declined requests for an interview. But his many admirers in the field believe he didn't accomplish more at Sony because he lacked adequate authority (the company disputes this) and because Tokyo didn't pay enough attention. Even today, they say, it can be hard for an American to wield significant influence in Sony's Tokyo headquarters. Says cyberexpert Lewis: "He felt a little frustrated."

"We are just not making enough money."

BIG SONY'S WOES just kept getting more dire. In May 2014, after announcing a projected $489 million loss for the fiscal year ending the following March, Hirai disclosed that he and 40 other top executives would again forgo their annual bonuses. (Lynton wrote the CEO, offering to forfeit his own bonus "to show solidarity." Much to his relief, Hirai declined the offer. "He gave me the bonus, the bet paid off," Lynton exulted in an email to a friend.) In September 2014 the company revised its projections dramatically downward. The company now expected a $2.1 billion loss.

Lynton was feeling stress. On Oct. 3 he emailed Pascal: "We are virtually a public company and we have made promises to Sony and the street as to what we will deliver for the next three years. I did not want to be in this situation, but events have overtaken us and so here we are. It is therefore very very important that before we take risky or marginal bets in a given slate we have a rock solid foundation to build on... I am about to go next week and make some big promises to Sony and we have to deliver on them... I am only saying all this so you understand the enormous pressure I am under and why I really don't have much patience at the moment." Five days later he emailed Pascal from budget sessions with Hirai in New York: "Meeting pretty rough... We are just not making enough money... Too much overhead. Not enough hits."

The emails suggest Lynton was going through a trying period. "Work is drudgery," he wrote a friend in September. He told another, "I haven't read a script in a month... A weird block that I can't explain." Lynton seemed more excited about his personal investment projects, which included Snapchat (he and his wife had provided seed money, and Lynton served on the board) and a scheme to develop a Breathalyzer-type device for detecting marijuana use. Emails show he pitched billionaire Dr. Patrick

Soon-Shiong on this "very commercial idea" and wanted to patent the concept. ("Michael Lynton spent minimal time on these outside interests," maintains Sony's spokesperson.)

Lynton was also wrestling with chronic insomnia and a bad back, along with the latest in a series of tax audits in California. (Sony's Lawson says there is "absolutely no connection between work pressures and any assumptions you are making based on stolen emails about Michael's medical conditions or personal tax matters.") Unbeknown to anyone at Sony, Lynton was also making plans to move with his family back to New York.

On Oct. 21, Sony finally got some good news. After a rise in Sony stock, Loeb had sold his stake at a profit of nearly 20%. He had remained in friendly mode for months, visiting Culver City for a private lunch with Lynton and other executives, dining with Seligman, and sending his hopes that Hirai had enjoyed his summer vacation in Hawaii. Publicly, Sony had treated Loeb as a respected investor who had raised helpful "concerns." But when he exited, there was unabashed delight. "Champagne for all!!!!" declared CFO David Hendler.

While Lynton was angling to leave, Pascal grew increasingly anxious over slow-moving negotiations for a new contract to stay. Her agreement was set to expire in March 2015. "You know ml will be as rude as possible and try and make me feel AKWARD instead of loved ...," she complained to Hollywood agent Bryan Lourd. "Tell me how to approach ml differently. Read art of war?"

She was already working with studio deputies and "vision" consultants to develop a plan to upgrade the anemic film pipeline. "I guess I [am] mad at him because this is our company and in some level I still think they are interlopers who are destroying it," she emailed studio president Belgrad on Nov. 12. "Isn't that silly? But I can tell you one thing. We will be there one way or another when everyone else has gone. I don't know if that is good or bad but I know it's true."

"There weren't any extreme hurdles in place."

FBI DIRECTOR JAMES COMEY has said he believes Sony's cyberattackers first breached the studio's network in September, gaining access through a common tactic called "spear phishing"—duping an employee into clicking on an email attachment or a web link.

INSIDE THE HACK OF THE CENTURY

MICHAEL LYNTON

"LYNTON ARGUES SONY WAS BLAMELESS, INSISTING IT WAS "EXTREMELY WELL PREPARED FOR CONVENTIONAL CYBER-SECURITY" BUT FACED "THE WORST CYBERATTACK IN U.S. HISTORY.""

Sony's traditional virus-detection programs provided no protection from the hackers' malware, since they block only previously identified attacks, and hackers know to make small changes in their code. Indeed, it's now accepted wisdom in the cyberworld that attackers can penetrate the perimeter defenses of almost any company.

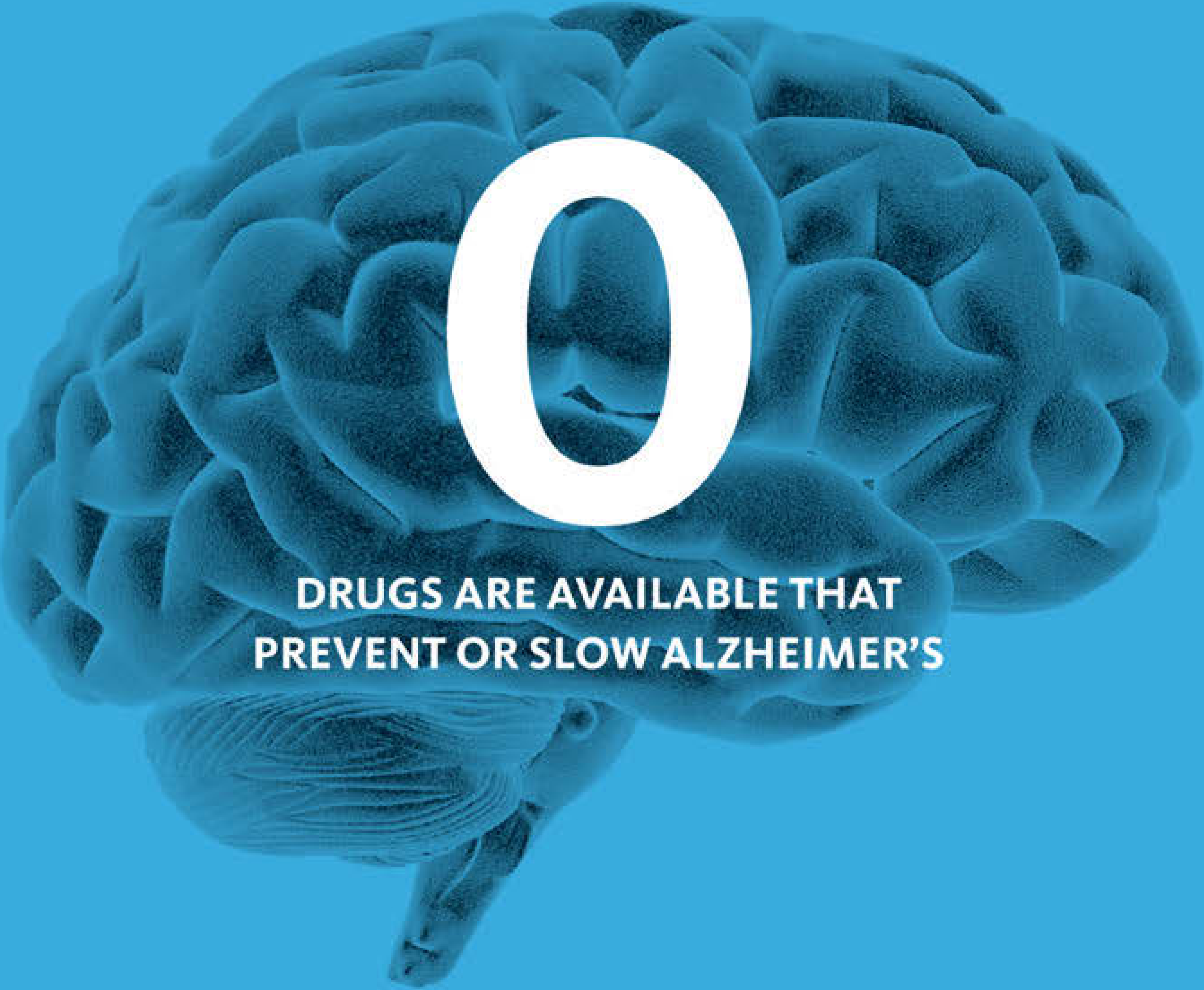
What's critical is detecting the intruders quickly, before they can do much damage. According to a 2015 report by Mandia's company, it typically takes a company 205 days to discover it has been penetrated, and less than a third of companies detect the breach themselves. This doesn't mean it's impossible to stop attacks; it's evidence that most companies haven't embraced the right precautions.

Once inside, the Sony attackers' next step was to "escalate privileges"—to gain wide access by stealing the credentials of system administrators. For more than two months Sony's hackers roamed freely, identifying what they wanted to steal. This was possible because the studio, with few exceptions, didn't segregate or provide extra security for even its most precious secrets. In effect, once the invaders made it past the network gates they could go anywhere they wanted because Sony hadn't locked any doors—much in the way that the company had left its information security department open and unattended.

It's "astounding" that the Sony hackers were able to remove so much without being noticed, says J. Alex Halderman, a University of Michigan computer science professor. Most corporate networks employ intrusion-detection software, which is designed to sound alarms about unusual file transfers—big files sent to strange places at unusual times—or odd behavior by system users accessing stuff they don't usually touch. This has fed suspicions that the Sony attackers had inside help providing access to its system—that someone downloaded its secrets onto portable hard drives (as Edward Snowden did at NSA), rather than sent them through the Internet.

Kevin Mandia, the prominent forensic expert Sony hired to investigate the hack, insists there is no evidence of that. The hackers, he contends, escaped detection by patiently moving data out in chunks over several weeks from different company servers to various attacker-controlled locations

LYNN GOLDSMITH—CORBIS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DRUGS ARE AVAILABLE THAT
PREVENT OR SLOW ALZHEIMER'S

around the world. As a media company, Sony routinely transfers giant files, making it harder to spot the theft.

Sony would not permit Mandia, chief operating officer of FireEye, to be interviewed by *Fortune*, allowing him to provide only a brief written statement. Sony has often cited a note Mandia provided to Lynton that asserts that no company could have been "fully prepared for" the attack. But that note was carefully worded. For example, it notes that "industry standard antivirus software" wouldn't have detected the malware. That's not saying much. To a cyberexpert, traditional antivirus protection offers the hacking equivalent of being able to repel a musket ball when today's villains are firing AK-47s.

Indeed, several cybersecurity vendors—including FireEye—claim their products would have prevented (or at least dramatically reduced) the devastation at Sony. Says FireEye spokesman Vitor De Souza: "If they had our solution, we probably would have spotted the malware used in the attack." De Souza says two-factor authentication also would have made a big difference at Sony. "It creates a big hurdle of the attackers," he says. "If you don't have two-factor authentication and they penetrate your network, you're in big trouble." If blocked, De Souza acknowledges, hackers might have employed other methods. "If a state actor wants to get in, he'll get in," he says. "The question is, How fast do you respond? Instead of, say, taking 10 terabytes of data, they might have gotten one."

After pilfering Sony documents, the invaders turned to swiping emails for five top studio executives; the most recent messages are dated just two days before the hackers detonated their attack. By that point they had stolen seven sets of credentials for system administrators and mapped the studio's entire network. This information was "hardcoded" into the destructive malware, allowing it to infect all the computers those IT managers were authorized to touch.

On Monday, Nov. 24, the attackers unleashed their customized wiper malware—igfxtrayex.exe—into Sony's network. On each machine the malware reached, it deleted everything on the hard drive while installing the threatening web page, with its skeletal imagery and warning. Anyone already logged in helplessly watched their files disappear. The malware also erased the software instructions that tell the computer how to operate. Two hours later the computer would restart to display another chilling message: "Operating system not found."

To avoid detection the hackers immediately exited Sony's network after launching their destruction. The malware reported back to "command and control" servers out in cyberspace, allowing the intruders—wherever they were—to tally up their digital toll. Hackers typically use the simplest means necessary to accomplish their mission, and experts say there was nothing particularly sophisticated about the Sony attack. Ed Skoudis, a "white hat" hacker who teaches cyberdefense testing for corporate IT security professionals at the SANS Institute, says the skill level deployed at Sony looks "pretty average." He puts its perpetrators on par with students in his midlevel classes. "It shows the defenses of Sony were not particularly good," says Skoudis. "I didn't see the bad guys jumping over any extreme hurdles, because there weren't any extreme hurdles in place."

What *was* extreme was the destruction.

"Pay the damage, or Sony Pictures will be bombarded."

FROM THE OUTSET, the management and employees at Sony Pictures didn't have a clue as to what hit them—or what was on the way. The studio's initial public comment on Nov. 24 was a marvel of understatement: "We are investigating an IT matter."

The invaders had spelled out their intentions in the scrolling text that accompanied the scarlet skeleton. "Hacked By #GOP," it read. "We've already warned you, and this is just a beginning. We continue till our request be met. We've obtained all your internal data including your secrets and top secrets. If you don't obey us, we'll release data shown below to the world."

Exactly what "obey us" meant wasn't clear. The initial message from the hackers, who later identified themselves in emails to selected reporters as the "Guardians of Peace," also praised another group: "Thanks a lot to God'sApstls contributing your great effort to peace of the world."

As it turned out, "God'sApstls" had emailed Lynton, Pascal, and three other Sony executives three days before the attack, demanding a payoff. "We've got great damage by Sony Pictures. The compensation for it, monetary compensation we want. Pay the

damage, or Sony Pictures will be bombarded as a whole. You know us very well. We never wait long. You'd better behave wisely." The menacing messages did not specify how much of a payoff was being demanded. Sony executives forwarded the email to the FBI, according to spokesperson Lawson.

Neither "God'sApstls" (which was never heard from again) nor the GOP had mentioned *The Interview*.

Hours after Sony's computers went dark, Nicole Seligman notified the FBI. That afternoon a team of agents from the agency's Los Angeles cybersquad arrived on the lot. Sony also retained forensic investigator Mandia.

Inside Sony Pictures, employees were left to work with pens and paper. The studio issued 190 BlackBerrys to key employees. Shops on the lot took only cash. "It is possible that some or all of this disruption will continue over the Thanksgiving Holiday," the studio advised them. "We appreciate your efforts to find work arounds."

Then, starting on Dec. 1, after again alerting reporters through emails, the hackers began dumping heaps of stolen documents, many of them deeply personal, onto file-sharing sites. The first batches included confidential performance evaluations, family medical records, criminal background checks, disciplinary memos over workplace affairs, passport information, and salary details for everyone at Sony. The studio had maintained little control over even sensitive information prized by identity thieves. Analysis by a data protection firm called Identity Finder found, for example, that Sony had left Social Security numbers for 47,426 people (including many who hadn't worked at the company for years) in more than 600 files lacking password protection or encryption.

More dumps followed, one every few days, each triggering a new crisis as reporters pored through Sony's business and, especially, its dirty laundry. "It was a nightmare," says one executive working on the studio lot. "Just when you think you'd gotten over one—it was starting to get quiet and calm—boom, you'd get hit with something else that was even crazier."

Pascal's email exchanges with producer Scott Rudin proved especially cringeworthy and were widely disseminated in the press. They included nasty comments about celebrities like Angelina Jolie (Rudin called her a "minimally talented spoiled brat"); insensitive banter about President Obama's presumed taste for black-themed films ("Should I ask him if he liked DJANGO?" she wrote); and knockdowns over their film deals ("Do not fucking threaten me," Pascal warned Rudin at one point. As she routinely did, Pascal forwarded this last exchange to Lynton, who scolded: "You are both crazy to put this in an email.")

KIM JONG-UN

KCNA—REUTERS

NORTH KOREAN HACKERS HAD BEEN BLAMED FOR THE "DARKSEOUL" ATTACK IN MARCH 2013. IT CAUSED $700 MILLION IN DAMAGE TO SOUTH KOREAN BANKS AND BROADCASTERS. THE ATTACKERS POSTED A NOTICE FEATURING IMAGES OF SKULLS.

After the embarrassing headlines, Pascal issued a public apology, then sought forgiveness in meetings with Sony employees and the Rev. Al Sharpton, who had threatened to demand her head over the Obama comments. "I feel like I've been raped," she privately told a studio visitor. "And I was blamed for it."

Sony tried vainly to bottle it all up. In mid-December the studio retained attorney David Boies, who warned 40 media organizations (including *Fortune)* not to use the stolen information or they would be held "responsible for any damage or loss." Boies asserted the documents were, variously, "private," "confidential," and "trade secrets," and protected under an array of U.S. and foreign legal doctrines. Many news outlets, including the *Wall Street Journal*, Bloomberg, and Reuters, published articles using the emails nonetheless. (Boies even wrote Twitter, seeking to shut down Val Broeksmit, leader of an indie band called Bikini Robot Army, whose tweeted screenshots of hacked Sony emails had won him 19,000 followers. Twitter suspended his account for just a day. Broeksmit, who was contacted by Boies, blew him off.)

That was all a sideshow. Sony's biggest problem was *The Interview*. The media first raised the prospect that North Korea had hacked Sony because of the film on Nov. 28, four days after the attack. The GOP made no reference to *The Interview* until Dec. 8, when it demanded that Sony, having "refused to accept" its previous terms, "stop immediately showing the movie of terrorism." Rogen and Franco, meanwhile, had continued their promotional tour, maintaining the studio's line—as Rogen put it on *Good Morning America* on Dec. 15—that *The Interview* "wasn't meant to be controversial in any way."

The GOP intensified its threats. It had already made ominous statements about the safety of studio employees' family members if its demands were not met. Then, on Dec. 16, the hackers, vowing a "bitter fate" for "those who seek fun in terror," claimed it would attack movie theaters screening

the “awful movie Sony Pictures Entertainment has made. The world will be full of fear,” they warned. “Remember the 11th of September 2001. We recommend you to keep yourself distant from the places at that time.”

The outrageous statements, made by an anonymous group seemingly able to wield great power, had their intended effect. Fear gripped the movie world. All five big theater chains, citing security concerns but also scared of ruining their holiday box office, told Sony they wouldn’t show the film. *The Interview* had been scheduled to open on 3,500 screens. Lost in the anxiety: word from the Department of Homeland Security that it had “no credible intelligence to indicate an active plot against movie theaters.”

On Dec. 17, Sony issued a statement, saying it was “deeply saddened at this brazen effort to suppress the distribution of a movie” and insisting, “We stand by our filmmakers and their right to free expression.” But Sony wasn’t standing by the movie; it was shelving it. “In light of the decision by the majority of our exhibitors not to show the film,” the studio announced, it was scrapping the Christmas release.

Lynton would later insist that the chains’ withdrawal had left him with no choice, commenting: “This was not our decision.” In fact, a group of at least 150 independent theaters were eager to show the movie. Tim League, CEO of Austin-based Alamo Drafthouse Cinema, says he quickly notified Sony that his 19-location chain wanted to show *The Interview,* as did other members of the Art House Convergence, made up of theaters across the country. But Sony refused to let them have it.

Late in the day on Dec. 17, when journalists asked about releasing the film through video on demand (VOD) or streaming services like Netflix—a way to bypass the threat to theaters—the studio issued a second statement ruling out any option: “Sony has no further release plans for the film.”

A day later the hackers demanded that Sony also yank “everything related to the movie, including its trailers.” The studio did this too, pulling TV advertising, canceling press screenings, even abandoning promotional Facebook and Twitter accounts. (Sony’s spokesperson says, “This was not an effort to appease hackers. There was no national release so the prudent thing to do was to stop the marketing efforts.”) *The Interview*, the press reported, wasn’t to see the light of day. The hackers had won.

BARACK OBAMA

OBAMA EXPRESSED SYMPATHY FOR SONY BUT SAID, “I WISH THEY HAD SPOKEN TO ME FIRST … WE CANNOT HAVE A SOCIETY IN WHICH SOME DICTATOR SOMEPLACE CAN START IMPOSING CENSORSHIP HERE IN THE UNITED STATES.”

ANDREW HARRER—BLOOMBERG VIA GETTY IMAGES

“Good thing they didn’t publish *The Satanic Verses.*”

IT WASN’T UNDERSTOOD at the time, but commercial considerations, not just fear, were shaping Sony’s actions. With the film’s hefty marketing budget mostly spent, Lynton was desperate to avoid eating a $65 million investment. He also wanted to calm panicked employees. Lynton opted not to release the movie immediately.

Hoping the big chains would reverse course (or agree to an alternative date), Sony was reluctant to permit a narrow art-house release, which would generate a pittance in box-office revenues. And if Sony moved forward with video on demand, the big chains—which insist on an exclusive viewing window—would never screen the film. The “no further release plans” statement would have reassured the chains, surely furious about rumors of VOD, buying time for Lynton to get them back onboard.

Over the 48 hours after it pulled the film, Sony again became a target, as critics from Hollywood to Washington voiced alarm that the studio had caved. “Sony’s decision to pull THE INTERVIEW is unsettling in so many ways,” tweeted writer Stephen King. “Good thing they didn’t publish THE SATANIC VERSES.” At a press conference on Dec. 19, President Obama blasted Sony, saying the studio “made a mistake.” Added the President: “We cannot have a society in which some dictator someplace can start imposing censorship here in the United States.”

By this point the calculus had shifted. There was no sign of movement among the theater chains. Lynton had begun secretly exploring the VOD option as a backup immediately after canceling the Christmas release. But he had no takers; online services were reluctant to make themselves the hackers’ next target. Sony could have offered the film on its own PlayStation Network, but it was also worried about security. (Both PlayStation and Microsoft’s Xbox Live would face cyberattacks on Christmas Day; a group calling itself the Lizard Squad claimed responsibility.)

Conspicuously absent from the media since the hack, Lynton appeared on CNN hours after the President’s comments, giving the first “exclusive” interview to Fareed Zakaria, a friend of Lynton’s. There the CEO insisted, “We have not caved … we have persevered, and we have not backed down.” Sony, he said, remained committed to distribut-


Dr. Maurie Markman, MD
Medical Oncologist
WHEN YOU DON'T KNOW WHAT TO SAY,
STAND UP.
When someone you love is diagnosed with cancer, you have the power to help. There are many ways you can stand up and show that you care.
THEY TALK, YOU LISTEN. One of the most helpful and important things you can do is listen—without judgment and resisting the urge to give advice.
DON'T ASK, DO TELL. Instead of waiting to be asked for help when it is needed, be specific about what you can do and when, such as: prepare a meal, babysit, pick up groceries, help with pets, or provide rides to and from appointments.
LIVE AND LEARN. Educate yourself about your loved one's diagnosis and treatment. When you understand what a cancer patient is going through, you're better able to help keep information clear, track questions, and know how you can be most useful.
STAY CONNECTED. After the initial diagnosis, people tend to drift away. Be someone to count on for the long haul. Check in, send a quick note, or drop off a book. Small gestures go a long way.
Visit ShowThatYouCare.org to learn more about how you can stand up for someone you love.
Pamela Cromwell
Cancer Survivor
Christina Applegate
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Cancer Treatment Centers of America
STAND UP TO CANCER
Cancer Treatment Centers of America is a proud supporter of Stand Up To Cancer, an initiative designed to accelerate groundbreaking cancer research for the benefit of the patient.
Stand Up To Cancer is a program of the Entertainment Industry Foundation, a 501(c)(3) charitable organization.

ing *The Interview* as soon as it could find a taker. "There has not been one major VOD—video on demand distributor—[or] one major e-commerce site that has stepped forward and said they are willing to distribute this movie for us," Lynton told Zakaria.

By Dec. 24, Lynton had given up altogether on the national chains—and found takers for VOD. Sony would allow the art-house theaters—ultimately, more than 300—to screen *The Interview* on Christmas Day. And he'd enlisted both Google and Microsoft, who'd first beefed up their cyberdefenses, to air the film on their VOD platforms. Starting that day, it would be available on Google's YouTube and Google Play and Microsoft's Xbox Video. Sony initially wanted to set a premium price—$17 for a 24-hour rental, Microsoft officials say. But ultimately, the studio recognized that would be another PR mistake and cut the price to $5.99 while touting the release as evidence of "our commitment to our filmmakers and free speech."

"Very high confidence" North Korea was to blame.

WHODUNIT? Twenty-five days after the hack, the FBI attributed the Sony attack to North Korea. The determination came extremely fast, and it was rare for the agency to identify a government as the culprit.

In a written statement and public comments, FBI officials cited similarities to the DarkSeoul episode, evidence that the Sony malware was constructed on computers with Korean language settings, Internet staging points for the attack, and—most intriguingly—intelligence from "sensitive sources and methods." At a Fordham University cybersecurity conference, FBI director Comey said he had "very high confidence" in this conclusion. (The *New York Times* later reported that U.S. intelligence, spying on North Korea, had found evidence of its role.)

Yet many experts remain unconvinced. It is easy, they note, for hackers to plant false clues. If the attackers' target was really Rogen's movie, why hadn't they mentioned it right away? How would North Koreans know what data to leak? How could they so skillfully navigate Sony's network? And why had they fallen silent after the release of *The Interview*?

"It's a dogpile," says Stuart McClure, CEO of cybersecurity firm Cylance. "'Well, that one is North Korea, and this one looks like it, so it must be North Korea.' There's no objective evidence."

SONY REVENUE BREAKDOWN BY SEGMENT (FY 2014)

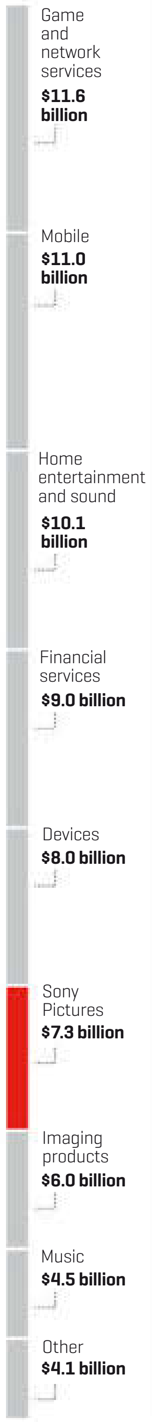


CHART SOURCE: SONY

Moreover, in the wake of revelations of secret government data gathering revealed by Edward Snowden, denizens of the electronic world are disinclined to take the government at its word. (The FBI has declined to make its evidence public.) Says Fordham law professor Joel Reidenberg, an information technology scholar who attended Comey's speech: "It was sort of 'Trust us, but we're not going to let you verify.'"

All this fed an alternative theory: Like an estimated one-quarter of cyberattacks, the Sony hack was an inside job. The most elaborate advocacy of this came from Norse, the firm that visited Sony to pitch its wares before the attack. Norse said its own investigation implicated a few bitter, laid-off Sony employees with IT savvy. On Dec. 29, Norse executives arrived at FBI headquarters in Washington to lay out their reasoning in a three-hour meeting. Immediately afterward the FBI issued a public statement, insisting there was "no credible information" to implicate anyone but the North Koreans.

Among the initial skeptics that North Korea was to blame: Amy Pascal, who didn't want to believe the film she backed had led to so much devastation. On Jan. 21 she met privately with Norse too, sitting down with her husband in their Los Angeles home to hear Stiansen detail his theories. Pascal later told a visitor that "for the longest time, I thought it was employees." Since then, Pascal has told friends, she is uncertain what to think. Norse officials say they now believe North Koreans pulled off the attack with "some assistance" from former Sony employees.

For Pascal, being studio chief hadn't been much fun for a while. But she wasn't ready to give it up, even after the public humiliation of having the world read her emails. After returning in late December from a family trip to Vermont, Pascal renewed her push for a new contract, which she'd told the company would be her last. She had made $47 million over the previous four years, and she wanted a comparable deal. She had been in negotiations with Sony for a new agreement since June.

But Lynton wasn't ready to move forward. After all, the film slate—the ultimate measure of Pascal's performance—hadn't met expectations for the past two years. And there was another consideration. As Lynton saw it, the events of the hack seemed to have

traumatized her. Pascal hadn't been visible around the studio much since Christmas, an emotional time for everyone, he told others. To Lynton, this lack of leadership had irreparably damaged her standing with employees. (Pascal has privately called this account "nonsense.")

So in late January, when Pascal demanded a final answer, Lynton decided it was no. He conferred with Hirai about the move. Then, on Saturday, Jan. 31, he met with Pascal at her home. He wasn't going to offer her a new contract as studio chief, Lynton told her. It would be better for her to become a big producer for Sony, an option they'd also been discussing. According to a Pascal friend, she was "shell-shocked."

Pascal's departure was announced the following Thursday. In a press release both sides cast her departure as her decision. But at a women's conference in San Francisco days later, Pascal bluntly declared that she'd been "fired." Still, she'd enjoy a gentle landing, helping produce some of Sony's biggest films, including *Spider-Man*. Depending on how they perform, insiders confirm, Pascal's package will give her \$30 million to \$40 million over four years plus a percentage of the profits her movies generate. In February, Lynton named Tom Rothman, a budget-conscious former Fox chief who'd been running Sony's TriStar brand, as her replacement.

Lynton recommitted himself to Sony. He signed a contract extension in February. While his wife and daughters would be moving to Manhattan, he would commute between the two coasts. "You may have heard this rumor that I'm moving," he assured employees at an all-hands meeting on Feb. 25. "I'm not." Added Lynton: "I am here to stay."

The Interview made one additional bit of history. After several days on VOD passed with no calamitous consequences, other online providers, including Apple, PlayStation, then Netflix, began offering it. So far it has brought in more than \$40 million on VOD, in addition to \$12 million in theaters worldwide, making it Sony's biggest digital seller ever, though still a loser for the studio.

The financial calculus is grimmer if you add in the out-of-pocket costs stemming from the hack: \$41 million through the end of March, according to the company. That's a bearable sum for a company of Sony's size. But there are a lot more costs to come. In

addition to expenses for investigation of the attack, IT repairs, and lost movie profits, Sony faces litigation blaming it for poor cybersecurity that exposed employees' private information. Seven cases have been consolidated into a proposed class action in Los Angeles federal court.

As Sony struggles to repair its reputation, it has also undertaken the challenge of reconstructing its blitzed computer network, this time with an array of precautions to resist—really resist—the next assault. Sony's "secure rebuild" strategy is expected to take a year, slowly returning the studio to normalcy while plugging the myriad weaknesses that its attackers so readily exploited.

The plan's premise is zero trust. It imposes precautions that Sony wouldn't previously countenance because they were too inconvenient and expensive. It's aimed at keeping bad guys out, preventing them from reaching anything valuable if they get in, and blocking them from stealing it if they do.

To resume operations safely, Sony began by building an entirely new "white network," completely segregated from the potential contagion of its old "black network." At the start Internet access was tightly restricted. Sony will keep as little information as possible on its active network; the rest will be stashed securely, encrypted and cut off from the Internet. Emails will be archived after just a few weeks. System administrators will have access only to areas required for their jobs. Employees will be barred from installing applications that aren't pre-approved. Sony will require everyone to use two-step login procedures. Firewalls will be put on the most restrictive settings. The studio will embrace an array of "next generation" cyberdefense technologies.

If implemented, it will represent a major step-up in cybersecurity for Sony. Will that be enough to prevent another cataclysm? Cyberexpert Lewis says that's the wrong question. "Think of it as a continuum of risk," he says. "You can do nothing, and you're at 100% risk. Or you can do a lot and you can get the risk down to 10% to 15%." The company was much closer to 100% risk last year and is heading much lower. That is undeniable progress. Now all Sony has to do is find a way to stop antagonizing hackers—and vindictive dictators. ■

Research associates: Marty Jones and Robert Hackett

The Innovation Transformation

IN TODAY'S INCREASINGLY DIGITAL WORLD, INNOVATIONS ARE BORN FROM NETWORKED INTERACTIONS BETWEEN PEOPLE, BUSINESS, AND THINGS. **ARE YOU READY?**

THE WORLD'S MOST NIMBLE companies have been rebuilding for a world in which systems are integrated and ready for change. "As our world becomes hyper-connected, it is producing a major shift where individuals, businesses, and societies are interconnected—all in real time—revolutionizing the way we live, how businesses operate, and how society functions," says Ana Ammann, senior director of global marketing, big data, and analytics services at SAP, a market leader in enterprise application software whose systems touch 74% of the world's transaction revenue.

In a study by McKinsey & Company, CEOs expect 15–50% of their companies' future earnings growth to come from disruptive technology. Profitability and success will depend on how organizations respond to challenges and prepare to capitalize on the opportunities. According to Ammann, companies in the best position to capitalize on this shift will be capable of supporting:

- **The Internet of Things:** Embedding sensors into devices, appliances, and vehicles will achieve optimization when everything is connected all the time. This will not only serve as an accelerator to creating new business models; it also means that new parts of our business experience will be digitized.
- **The Business Network:** New patterns and models will emerge as business processes that used to stop at the walls of the enterprise are extended to vendors, suppliers, partners, governments, financial institutions, and other entities. Frictionless commerce will develop across goods and services, contingent workforces, and travel and entertainment.
- **People:** Cultivating a workforce across geographies, growing new leadership skills, and allowing employees the freedom to integrate their talents, expertise, and interests into their work: We will see this happen as mobile technologies bring more flexibility into the workday.
- **Customer Experience:** These companies will provide customers richer and more engaging experiences driven by a deeper understanding of individualized preferences through better tracking and analysis of their data.

UNDERGOING THE DIGITAL TRANSFORMATION

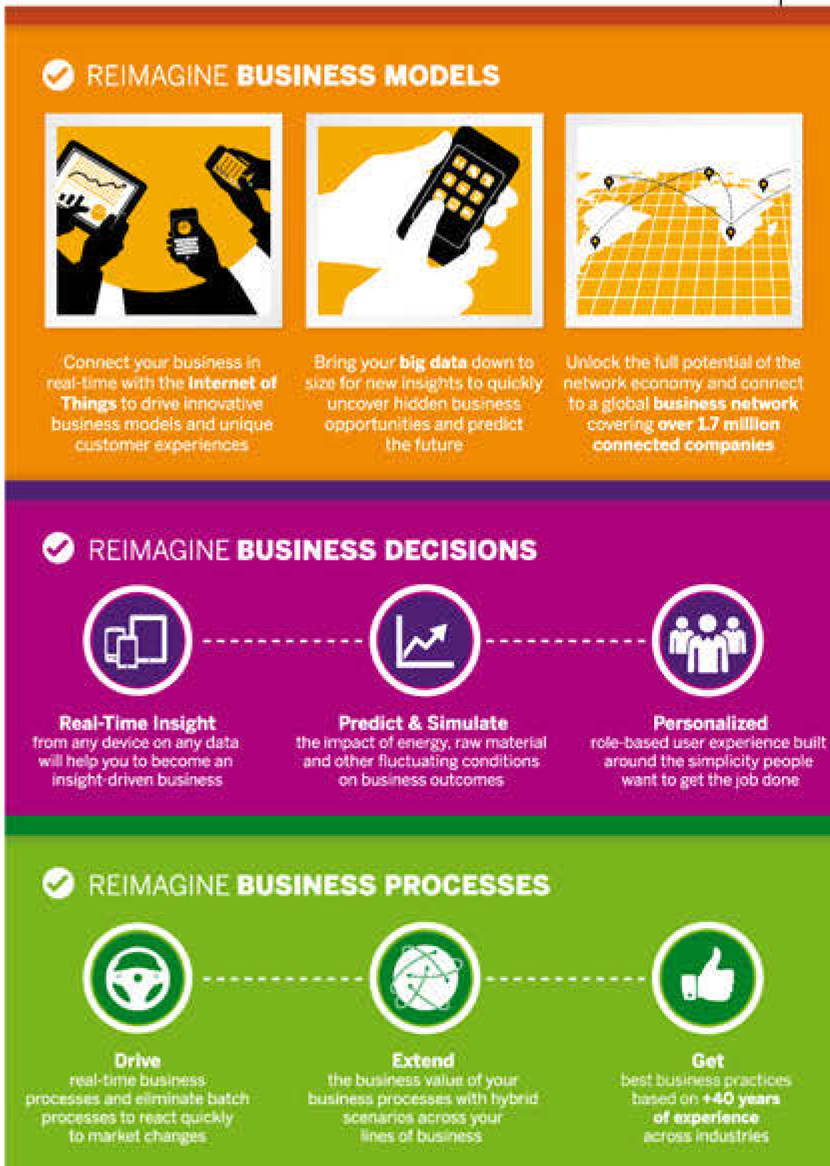
If a company wants to lead in its industry, it needs to embark on a "digital transformation," says Richard Strattner, senior director of global marketing at SAP.

Most executives want to transform their operations, but many are working in large and complex organizations—and that complexity makes it difficult to evolve. An SAP-sponsored *Harvard Business Review* study found six out of 10 business managers say complexity increased operational costs by at least 11%. And according to SAP, businesses spend 66% of their IT budget to maintain the status quo; a CIO of a $20 billion company typically has about 1,000 applications to manage.

If companies are too busy overseeing multiple systems or too focused on their day-to-day operations, they won't be able to innovate. "Complexity in decision making, business processes and information management lies in the way of companies embarking on their digital transformation journey," says Amr El Meleegy, SAP's senior director of product marketing. "For enterprises to succeed in their digital trans-

"Thriving in this era of digital ubiquity is about optimizing experiences and staying relevant." — *ANA AMMANN, GLOBAL MARKETING EXECUTIVE, SAP*

formation they need to tackle these complexities which more often than not are rooted in IT."



CREATING A FOUNDATION

For more than 40 years, SAP has helped executives reimagine the way they do business. Through its technology and consulting services, the company has guided over 290,000 clients in more than 170 countries in the innovation and simplification of their operations. "It's about helping customers build a digital foundation that can assist them in reinventing their business models, offer new customer experiences, better engage with their workforce, suppliers, and partners, and drive new operational efficiencies," says El Meleegy.

To address these challenges, this year the company launched SAP Business Suite 4 SAP HANA (S/4HANA), a next-generation business application designed to help enterprises simplify in today's digital economy.

S/4HANA fundamentally redefines how enterprise software creates value across industries, with instant insight and real-time connections to big data, the Internet of Things, and business and social networks. "It's more than an application; it's a foundation that enables digital transformation in a more refined way," says Ammann. "Businesses can simplify and reinvent their processes, change them as needed to gain efficiencies, and get insight on any data in real time. They have access to personalized information and recommendations on the fly while driving business decisions with confidence leveraging a single trustworthy version of data, combined with advanced and predictive analytic capabilities."

SERVING CLIENTS FASTER AND SMARTER

Companies can now enhance their customers' experiences, provide guidance, and even predict what they need before they know they need it. "Curating the integration of digital and physical experiences down to the level of the single customer is becoming the new norm. Organizations are looking to technology leaders like SAP to help them undergo a digital transformation to revolutionize their customers' experiences," explains Strattner.

For example, in the world of travel, when a flight is delayed, an airline can run simulations on the impacts of the delay on all affected travelers. With SAP technology, data crunching—which used to take several hours to come up with alternative travel scenarios—can now be completed before the traveler is even aware of a problem and the airline has rerouted them.

In the retail space, major players are staying relevant with their customers by becoming lifestyle advisers. Media, music, and publishing companies are changing how consumers entertain themselves. These and other disruptive models are forcing businesses in all industries to think outside the traditional boundaries to find ways to innovate.

"To be able to adapt to these ever-changing dynamics, organizations require a digital foundation built on the latest technology and thousands of examples of best practices, and that is something SAP does best," says Ammann.

Find out how SAP Service and Support can help you envision and implement an innovation foundation that's right for your enterprise. Visit sap.com/S4HANA.

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BRAINSTORM TECH 2015

The Education of Brian Chesky

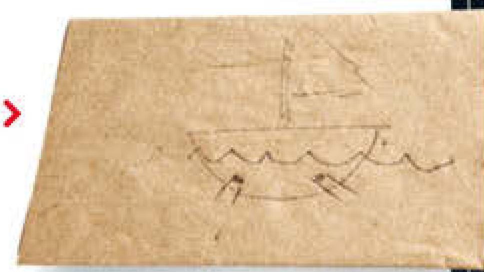
Coming up with the idea for **AIRBNB** was the easy part. The transition from broke art-school graduate to multibillion-dollar company CEO? That was more complicated. Here's how the sharer-in-chief hacked leadership.

Chesky in the President's Room at Airbnb's San Francisco headquarters. The former battery factory is home to 900 of the company's roughly 2,000 global employees.

BY
LEIGH GALLAGHER

PHOTOGRAPH BY
MICHAEL LEWIS
LETTERING BY WETE

(Actual napkin pictured.)



Brian Chesky is drawing intently on a napkin.

We're sitting in the President's Room at Airbnb's airy, ultra-chic headquarters in the SoMa neighborhood of San Francisco. Other meeting spaces in the historic building, which the company moved to in 2013, are designed to replicate an Airbnb rental in Fiji or the war room from the movie *Dr. Strangelove*. With its wood-paneled walls, leather club chairs, and a model of a ship on the coffee table, the President's Room retains the feel of the original executive quarters from 1917, when the building was built to house a battery factory. After a moment of serious sketching, Chesky holds up the napkin to show me his picture: It's a boat. And, it must be said, for a graduate of the Rhode Island School of Design it's a rudimentary-looking vessel. But the quality of the drawing is not the point. I've just asked Chesky how his management style has evolved, and the boat is his answer. ¶ "If you think about it, Airbnb is like a giant ship," he says, holding up the napkin. "And as CEO I'm the captain of the ship. But I really have two jobs: The first job is, I have to worry about everything below the waterline; anything that can sink the ship." He points to the scribbled line of waves that cuts the boat in half, and below that, two holes with water rushing in. ¶ "Beyond that," he continues, "I have to focus on two to three areas that I'm deeply passionate about—that aren't below the waterline but that I focus on because I can add unique value, I'm truly passionate about them, and they can truly transform the company if they go well." The three areas he's picked: product, brand, and culture. "I'm pretty hands-on with those three," he says. "And with the others I really try to empower leaders and get involved only when there are holes below the waterline."

IT'S A HIGH-LEVEL, strategic way of thinking about management, something that sounds more out of the playbook of Jim Collins or Peter Drucker than a 33-year-old first-time CEO. And in fact there is an outside source for this bit of wisdom, but it's not what you might expect. Chesky learned the boat theory from George Tenet, the director of the CIA from 1997 to 2004 and now a managing director at the investment bank Allen & Company. Chesky was introduced to Tenet a few years ago and asked to set up a meeting.

It may seem odd for Chesky, the CEO of the company that, along with ride-sharing giant Uber, has become the poster child for the so-called sharing economy, to seek advice from the man who signed off on the intelligence that led to the 2003 U.S. invasion of Iraq. But Tenet is just one of a long list of leaders Chesky has sought out since co-founding the home-rental website—some inside the box and some very far outside it. Others he's reached out to for lessons include Berkshire Hathaway's Warren Buffett and Disney CEO Bob Iger; a long list of tech luminaries that includes Apple's Jony Ive, LinkedIn's Jeff Weiner, and Salesforce.com's Marc Benioff; and a separate group he's taken posthumous lessons from, including Steve Jobs, Walt Disney, George Bernard Shaw, and Dwight D. Eisenhower. "It's kind of like the old Robert McNamara saying," says Chesky, referencing a comment about nuclear weapons by the controversial 1960s U.S. defense secretary to explain his own voracious pursuit of manage-

Chesky, center, in 2012 with Airbnb co-founders Nathan Blecharczyk, left, and Joe Gebbia at the company's former headquarters

THIS PAGE: JAKE STANGEL; OPPOSITE PAGE: MANFRED KOH PHOTOGRAPHY

ment knowledge. "There's no learning curve for people who are in war or in startups."

Indeed, the past seven-plus years have been a combination of exhilarating, nerve-racking, and flat-out surreal for Chesky. Hatched in 2008 on a whim, Airbnb is now a massive platform that has been used by 40 million people. As this story went to press, the company was reportedly close to raising $1 billion in a new round of funding that will give it a valuation of $24 billion, a figure that exceeds the $21 billion market value of hotel giant Marriott, which runs more than 4,000 hotels. Among so-called unicorns, tech startups with valuations of more than $1 billion, Airbnb trails only Uber (reportedly close to closing a new round of funding at a value of $50 billion) and Chinese phonemaker Xiaomi ($46 billion). Airbnb will reportedly bring in around $900 million in revenue this year.

It wasn't so long ago that the preparation for running a company of that size came only one way: by working one's way up through the ranks, demonstrating "leadership potential," and then embarking on a years-long process of being moved through a series of CEO-in-waiting posts. But the current tech-industry climate has turned that thinking on its head. Young people with a single, powerful business idea are thrown into CEO positions by default and not by training, and it happens very, very quickly. And while no unicorn is without investors and other advisers offering plenty of opinions and advice, the CEO is largely on his own, steering the ship—and occasionally drawing it on a napkin.

Chesky, who in 2008 had never heard of an angel investor or read TechCrunch, knows this better than anyone. "It's not natural for someone like myself to be at art school, to then be unemployed, and then five or six years later have this," he says. "Nothing really prepares you for that."

His solution, then, has been to hack leadership by going far and wide in search of best practices. So far, that approach seems to be working for Chesky, thanks in part to the fact that he has a temperament well-suited to the quest for mastery, as we'll see. But the story of Chesky's evolution as an executive also offers a window into the way the new economy has turned conventional CEO-ing upside down—and may offer a new playbook for leadership development.

ASK ANYONE WHO KNOWS CHESKY what he's like, and he will say one of a few things: Intense. Focused. Really, really, *really* curious. As soon as we sit down to talk for this article—the first in-depth profile of Chesky himself, rather than the company—he starts quizzing me about the process. He's surprised that he is actually the subject of an entire story. He wants to know how the day is going. I list the half-dozen executives I've already interviewed. "Wow, this feels like a 360-degree performance review," he says. "The only difference is the whole world will read it." He presses on: "What are the themes? Or do they come later?"

By now, the story of Airbnb's origin is lore in Silicon Valley and beyond: In October 2007, Chesky and Joe Gebbia, two unemployed RISD graduates, were broke and staring at their rent due date. So they came up with the idea to pull some of Gebbia's air mattresses out of the closet and

sell sleeping space in their apartment to attendees of a sold-out design trade show. They called it the Air Bed and Breakfast. (The "continental breakfast" consisted of untoasted Pop-Tarts.) Three people bunked with them that weekend, and the idea got some attention on design blogs. A few months later their engineer friend Nathan Blecharczyk joined Chesky and Gebbia as the third co-founder, and in August 2008 the site debuted as Airbedandbreakfast.com, an online platform for people to rent out space in their homes. Chesky gravitated naturally to the role of leader, with Gebbia focused on design and Blecharczyk on technology.

Many experts and Silicon Valley luminaries were highly skeptical of the Airbnb concept at first. But the idea took hold, and the following spring the founders were accepted into the prestigious startup incubator Y Combinator, run by venture capitalist Paul Graham. They soon shortened the name to Airbnb and expanded from offering shared spaces to properties including entire homes and apartments, castles, boats, and tree houses. In November 2010 the trio got their first round of VC funding. Today Airbnb has roughly 2,000 employees operating out of 21 offices worldwide, and offers its service in 34,000 cities.

Ask Chesky what he didn't know about management in the early days, and he barely knows where to start. "It's kind of like, what *did* I know?" he says. But he had no choice but to plunge in; the company couldn't wait for him. Chesky says he learned two ways: first by trial and error ("it's the old adage about jumping off a cliff and assembling the airplane on the way down"), and second by teaching himself how to go deep on subjects fast—specifically, by using a process he calls "going to the source."

Rather than trying to learn every single aspect of a particular topic, Chesky found that it was more efficient to spend his time researching and identifying the single best source in that area, then going straight to that person. "If you pick the right source, you can fast-forward," he says. It's an approach that has served him again and again.

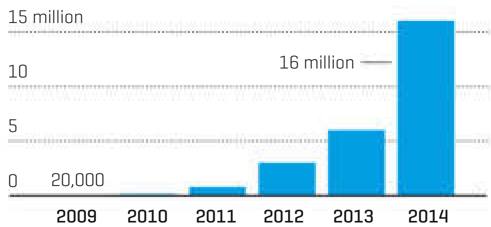
Chesky and his co-founders' first "sources" were their earliest advisers, tech entrepreneur Michael Seibel and Y Combinator's Graham. Reading was also an early part of the regimen. For Chesky, a source may come in the form of a biography of a business hero such as Steve Jobs or Walt Disney. His primary book source on management technique is Andy Grove's *High Output Management.* To learn the ins and outs of hospitality, he went to the *Cornell Hospitality Quarterly,* a scholarly journal published by the Cornell University School of Hotel Administration.

As the company became more prominent, so did Chesky's sources. Soon came meetings with Facebook's Mark Zuckerberg, Amazon's Jeff Bezos, and eBay CEO John Donahoe. He went to Bob Iger and Marc Benioff to ask how they push their executive teams to do more. From Facebook's Sheryl Sandberg he picked up tips about efficiency in scaling internationally.

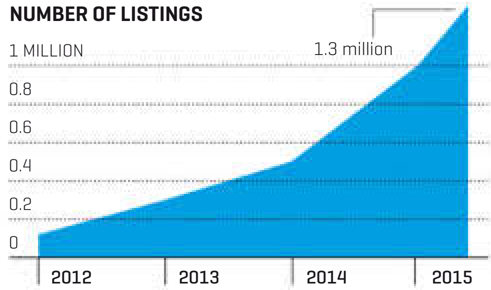
A key aspect of Chesky's sourcing theory is what he calls "synthesizing divergent ideas"—basically, going to unexpected sources for insight.

As a kid, Chesky slept with his hockey stick. Now his company's growth chart resembles one. Some 40 million people have stayed in an Airbnb since 2008.

ANNUAL NUMBER OF AIRBNB GUESTS



NUMBER OF LISTINGS



To learn how to become an elite recruiter, for example, Chesky might skip talking to an HR exec and instead seek out a sports agent, whose business lives and dies by attracting talent.

Similarly, Chesky reached out to Tenet not for tips on global security, but for corporate culture: How do you create an open and transparent atmosphere when you're in the business of secrets? From their conversation, he took away the importance of "walking the park," Walt Disney's theory of being a visible manager. Tenet told Chesky he would eat lunch in the cafeteria every day and sit at a different seat. Chesky says Tenet also taught him the importance of sending handwritten notes to employees. The former CIA chief told him that some of the most meaningful moments in his job were when he'd see a card he wrote an employee years ago still tacked on to his or her wall. And, of course, he gave Chesky the boat theory.

One of Chesky's biggest source triumphs was his audience with Buffett. A little over a

GRAPHIC SOURCE: AIRBNB; OPPOSITE PAGE, FROM LEFT: RICHARD DREW—AP; DAVID M. BENETT—GETTY IMAGES FOR SUSHISAMBA LONDON; AMANDA EDWARDS—WIREIMAGE/GETTY IMAGES; MONICA SCHIPPER—WIREIMAGE/GETTY IMAGES; MATTHEW STAVER—BLOOMBERG NEWS/GETTY IMAGES

Chesky's Chiefs

BEFORE HE LEARNED how to lead, Brian Chesky had to learn how to learn. His shortcut: seeking counsel from a wide range of sources. Here are just a few—and what he learned from each.

SHERYL SANDBERG
COO, Facebook

LESSON: Be proactive.
Chesky went to Sandberg for her thoughts on scaling internationally, but she also told him that as CEO, people would soon stop telling him the truth—if it hadn't already happened. He learned to ask more probing questions.

JONY IVE
Chief design officer, Apple

LESSON: Focus.
From Ive, Chesky learned the Jobs-ian art of staying disciplined and resisting the temptation to chase every promising idea. Chesky likes to mention how Apple can fit every product it makes onto one kitchen table.

BOB IGER
CEO, Disney

LESSON: Stay cool.
Iger had to integrate Pixar and please Steve Jobs, who "was not the easiest guy to work with, but [Iger] made him feel great about the process." Chesky adds that Iger has "the kind of composure that oftentimes founders don't learn."

WARREN BUFFETT
CEO, Berkshire Hathaway

LESSON: Avoid "noise."
When he went to visit Buffett in Omaha, Chesky was struck by how the legendary investor largely avoids television and meetings, spending most of his day reading. "He thinks so deeply," Chesky says.

GEORGE TENET
Former director, CIA

LESSON: Be visible.
Chesky sought out Tenet's beliefs on culture, including the importance of being visible—Tenet used to eat at the CIA cafeteria, sitting in a different seat each day—and recognizing employees with handwritten notes.

year ago, Chesky reached out and asked if he could travel to Omaha to have lunch, in part to talk about how Airbnb might help expand the number of rooms available in town during Berkshire's annual meeting weekend. The discussion ended up lasting 4½ hours. Chesky's biggest takeaway: the value of not getting caught up in the noise. "He's literally in the center of Omaha," Chesky says. "There's no TVs anywhere. He spends all day reading. He takes maybe one meeting a day, and he thinks so deeply." The experience made such an impact on Chesky that he went to the airport, and, afraid he would forget the conversation, immediately wrote a 3,600-word report and sent it to his team. For his part, Buffett says he sensed in Chesky a genuine passion for building his company: "I think he would be doing what he's doing if he didn't get paid a dime for it." Buffett's take on Airbnb? "I wish I'd thought of it."

Communicating the various pieces of wisdom he picks up as he learns them is a key part of Chesky's management style. Earlier this year he started a "Sunday night series," a weekly all-company email summarizing a principle or lesson he'd learned. A recent three-part series focused on—fittingly—how to learn.

CHESKY HAS BEEN OBSESSIVE about his pursuits since childhood. "From a very young age, you could see that he didn't just dabble in something," says his mother, Deb Chesky. Brian grew up in Niskayuna, N.Y., outside Albany, the son of two social workers. (His sister Allison, five years his junior, is a fashion editor at *Real Simple,* which is owned by *Fortune*'s parent, Time Inc.) Chesky's first passion was hockey. After he got a full set of gear for Christmas one year, he insisted on sleeping in it—pads, skates, stick, and helmet. Later a hobby of drawing and redesigning Nike sneakers grew into a passion for art. He would disappear to the local museum for hours to draw replicas of the paintings.

His natural leadership potential surfaced at RISD, where he served as the captain of the hockey team and was eventually selected to be the commencement speaker at his graduation. Chesky threw himself into the task, studying every commencement speech he could find; to make the experience less intimidating, the night before his address he stood at the podium and watched as the staff set up 6,000 chairs one by one. "Who does that?" muses Deb Chesky.

After graduation, Chesky's friend and classmate Gebbia told him that he had a premonition they were going to launch a business together. "I said, 'Before you get on the plane, there's something I need to tell you,'" says Gebbia. "'We're going to start a company one day, and they're going to write a book about it.'" Chesky first moved to L.A. to become an industrial designer, but soon decided to join Gebbia in San Francisco. Eventually, they ran short of rent money, and inspiration struck.

THE BIGGEST LEADERSHIP lesson for Chesky so far came from the company's most significant crisis to date. It started when a San Francisco host's home was burglarized and ransacked by renters in June 2011. The company initially put forth a lackluster response from Chesky, but the host—a woman known as "EJ"—rebutted in a blog post his claims that the company had done everything it could to help her. Then Airbnb went silent, and the story got louder.

Inside Airbnb everyone had a different opinion on how to handle it. Some argued that taking responsibility would just open the door to more complaints; others said to put the truth out there; still others said the company should stay totally quiet. The situation dragged on for weeks. "I finally had this really dark moment and I got to the point where I wouldn't say I stopped caring, but my priorities completely changed," says Chesky. "And I basically said I should stop managing for the outcome and just manage to the principle." He needed to apologize, Chesky felt, even if it might hurt the company.

Chesky composed a strongly worded letter accepting responsibility. "Over the last four weeks, we have really screwed things up," he wrote. He not only said he was sorry but also announced that the company would be implementing a $50,000 guarantee. "All of this was against advice," Chesky says. "People were like, 'We need to discuss this, we need to do testing,' and I said, 'No, we're doing this.'" He did have a key assist from one major source. Marc Andreessen, co-founder of VC firm Andreessen Horowitz and an investor in Airbnb, added a zero to the amount of the guarantee, which Chesky had first set at $5,000.

Chesky's primary takeaway from the experience was to stop making decisions by consensus. "A consensus decision in a moment of crisis is very often going to be the middle of the road, and they're usually the worst decisions," he says. "Usually in a crisis you have to go left or right."

For his team, it was a defining moment in their confidence in him as a leader. "That's when I really saw what Brian was made of," says Joe Zadeh, head of product management. "That was the turning point where I had 100% confidence in this company's leadership and was ready to take any challenge the world threw at us."

BRIAN'S RULES
Chesky has absorbed management lessons from the pros, but he has also developed his own leadership principles.

- **1. GO TO THE SOURCE**
If you have a limited amount of time to learn something, spend most of your available time identifying the best source on the topic—then go to that person: "If you pick the right source, you can fast-forward."

- **2. AMPLIFY YOUR MOVES**
Devote your energy to actions that have the greatest impact. "It's like chess," Chesky says. A few key moves can give you the leverage to make other moves.

- **3. DON'T LEAD BY CONSENSUS IN A CRISIS**
"Usually in a crisis you have to go left or right, and everyone wants to go middle. And middle is the storm."

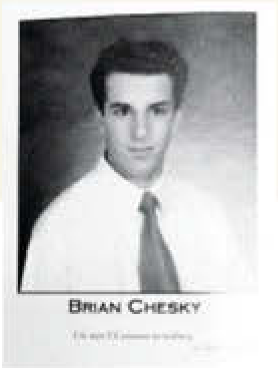
- **4. REFILL THE RESERVOIR**
The best CEOs take inspiration from their outside lives. "If you stop going to fairs, concerts, and bars, and you're just working, you lose touch with all that. You have to refill the reservoir."

DESPITE ITS RAPID GROWTH, Airbnb has endured plenty of challenges. The service runs afoul of local laws and regulations in many cities in which it operates. In its hometown of San Francisco, until recently, all short-term residential rentals without a permit were banned. Landlords, co-op boards, and urban neighbors are often hostile.

New York, which passed a bill in 2010 saying that owners or tenants can't legally rent their apartment out for less than 30 days unless they're living in the same space, has been a particularly tough battleground. The attacks on Airbnb got so bad in 2013 that Chesky went on a charm tour, meeting with dozens of politicians, hoteliers, real estate moguls, and influential members of the press. The tenor of the conversation in New York changed after the tour, but the city hasn't budged on the law. Other markets, though, have been opening up: A new law in San Francisco legalizing short-term rentals went into effect in February. Nashville, Philadelphia, and San Jose have announced similar legislation, as have London and France. "I think we're moving away from the divisive era into the more mainstream era," Chesky says.

Airbnb is often seen as a competitor to the major hotel chains. Chesky challenges that view and insists that hotels have continued to thrive even as Airbnb has grown. He says that these days Airbnb has a "pretty healthy relationship" with the likes of Marriott, Hilton, and Starwood. In 2013, Chesky recruited Chip Conley, founder of the Joie de Vivre hotel chain and a respected figure in the industry, to focus on hospitality. Conley says executives from four of the six biggest hotel chains have come to the Airbnb headquarters for a day of "immersion."

But the more Airbnb grows, the more it has the capacity to take business from hotels. Last year the company launched Instant Book, a new category of listings that don't require ap-



Left: Chesky's high school yearbook photo with a Jerry Seinfeld quote, "I'm sure I'll amount to nothing." Right: Chesky and girlfriend Elissa Patel at the *Time* 100 in April.

proval from the host and allow for immediate, hotel-like booking. Now Airbnb is making a push into business travel, including a partnership with travel management company Concur that has seen Airbnb land some 150 corporate accounts so far. It's likely that the mainstream era will be just as competitive as the one Airbnb is leaving behind.

IT'S A WEDNESDAY in early February, and Chesky is standing on a stage at Pier 48 in San Francisco. This is One Airbnb, the company's week-long annual all-hands confab, and more than 1,800 employees are packed into the venue for Chesky's keynote address. He talks about the importance of being "crazy"—of not "editing your imagination," not listening to the voices that say something's not possible. Safety questions, legal challenges, competitors—none of those things can destroy Airbnb. "The thing that will destroy Airbnb," he says to thunderous applause, "is if we stop being crazy."

Chesky is particularly obsessive when it comes to culture. In 2012, he asked another key source—the iconoclastic investor Peter Thiel—for the best advice he could offer. Thiel's immediate answer: "Don't fuck up the culture." Thiel said it was almost inevitable that the culture would go awry once a company reached a certain size. So Chesky doubled down on his focus. "If you break the culture, you break the machine that creates your products," he wrote shortly thereafter in a missive to employees. He welcomes new hires each week with an hour-long Q&A session in which he encourages them to be bold and to be "crazy." His passion for his product occasionally verges on evangelism, such as when he tells employees they are there to "design the future world we want to live in."

After years of his own executive education, Chesky has collected a cabinet full of philosophies, opinions, truisms—and a healthy dose of jargon. Chesky talks a lot about "up-leveling," or pushing himself and others to think bigger. That's not to be confused with "skip-leveling"—the process of talking to people at all levels of the organization. Chesky is also fond of discussing "step changes," or single moves that have a great effect.

But Chesky is quick to acknowledge that he still has weak points. He takes too long to hire executives, he says, and also too long to acknowledge when things aren't working out. Another skill he's still perfecting: the art of listening. Chesky says that when he was 6 years old his parents had his hearing tested. "They thought I had a hearing problem," he says. "Apparently I just had a listening problem." Chesky is working on it, but says that he has so much energy and is so "action-oriented" that it can appear that he isn't listening when he is. Investor Graham says Chesky's approach may not be out of the Harvard Business School playbook, but it's effective. "He's sort of missing all the stuff they teach at HBS," says Graham. "But he's the kind of leader who leads people to do things that he himself believes in."

In Andreessen's view, Chesky's biggest challenge is the sheer amount of information he has to process while growing such a fast-moving organization. "Some people lean into that," says Andreessen. "Brian loves it. One of the things that makes him distinctive is he's up for the challenge." Andreessen says he views him as "one of the best new CEOs since Mark Zuckerberg."

THIS HAS BEEN something of a breakout year for Chesky. In April, he was on the *Time* 100, and his presence at the White House Correspondents' Dinner (seated at *Fortune*'s table) made headlines as a symbol of Silicon Valley's growing presence in Washington. In May, President Obama appointed Chesky a presidential ambassador for global entrepreneurship.

Even as his profile rises, however, Chesky has been working on a new project: finding balance. He has learned that if he is going to stay in his job for the long run, he must develop techniques to "refill the reservoir." The key source in that effort is Elissa Patel, his girlfriend of two years (they met on Tinder), who recently left photo app Frontback to start her own venture. They do yoga together every Thursday morning. And since Chesky's apartment is still listed on Airbnb—yes, you can Airbnb the CEO's pad—the occasional guest joins in. He and Elissa often do "staycations," booking an Airbnb in a different neighborhood just to experience it.

Looking to the future, Chesky says that not a single one of Airbnb's investors has pressured him to take the company public anytime soon. But he's well aware of the expectation that an IPO will happen eventually. And he does offer a little hint on timing. "If we decided we wanted to go public, we'd want to give ourselves a couple years to really prepare, to have that runway," he explains. "I always thought of it as a two-year project. And we won't start thinking of that for at least a year, and maybe two years."

That should give him plenty of time to get his sources lined up.

FEEDBACK *letters@fortune.com*

LEFT: COURTESY OF AIRBNB; RIGHT: TAYLOR HILL—GETTY IMAGES

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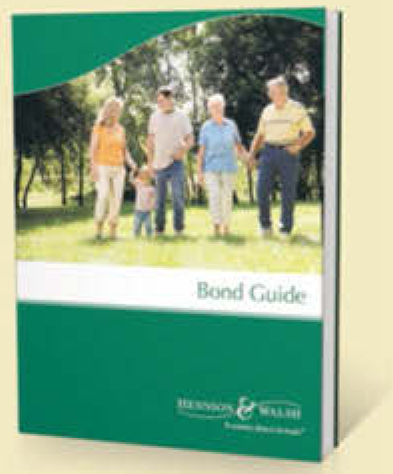

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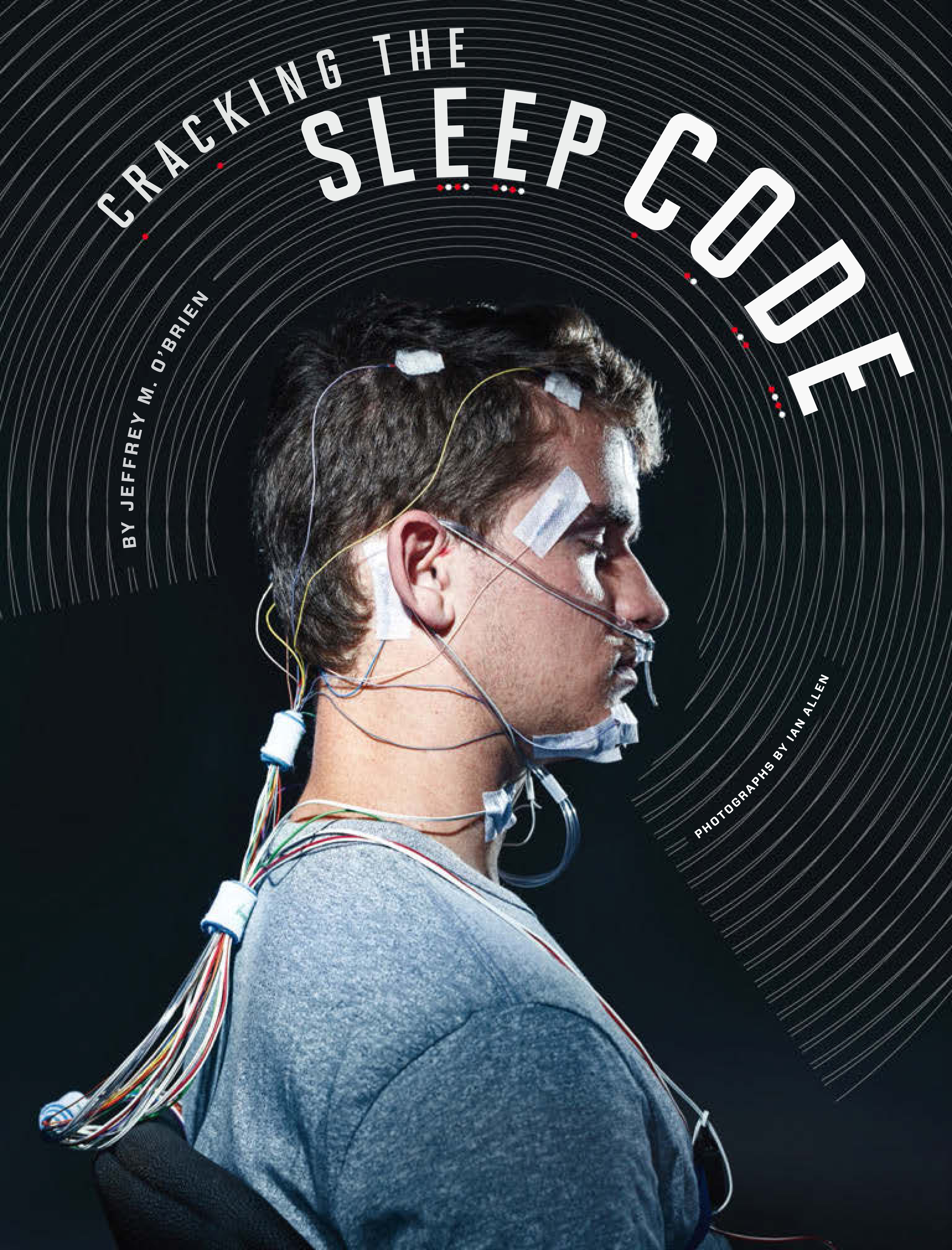
CRACKING THE SLEEP CODE

BY JEFFREY M. O'BRIEN

PHOTOGRAPHS BY IAN ALLEN



BRAINSTORM TECH 2015

Can big data—and input from millions of fitness trackers—unlock the mysteries of our national insomnia?

Far left: An employee of Fullpower Technologies, rigged for a sleep study in the company's lab. This page: The "head box" transfers input from body sensors to a base station that processes the data to create a personal polysomnogram.

Philippe Kahn says Fullpower is "operating a huge sleep experiment unlike anything anyone has ever done."

I'm playing tennis with Marissa Mayer, and

oddly, the Yahoo CEO is wearing a pearlescent purple gown and sipping from a teacup. Her dress is just long enough to obscure her feet, so she appears to be floating across the baseline. As she strikes the ball, she tips her chin skyward and laughs in slow motion. ¶ Meanwhile, I'm perched in the lotus position atop a manta ray that's hovering above the ground like some kind of Landspeeder. And I'm panicking. How can I keep my balance and still hit the ball—especially with my shirt collar pulling at my neck the way it is? Can't swing my racket. I jerk my head left. Then right. I claw at my jawline. The ball has cleared the net, and it's headed my way. If only. I could. Just. Move. My head. ¶ And poof. She's gone. I open my eyes in a strange room. It's pitch dark and completely silent, but I manage to find my bearings. Santa Cruz, Calif. Breathing heavily, I carefully disentangle a gaggle of wires twisted around my neck and roll over to glance at the clock. Just after 3 a.m.

THIS SCENE, I NOW KNOW, was merely one of 18 REM-sleep interruptions that I experienced between 11:18 p.m. and 6:16 a.m. during one long February night. What a strange setting for the only dream I've ever had about a chief executive: in a laboratory, tethered to a byzantine apparatus designed to monitor my brain activity as well as every breath, eye movement, muscle twitch, and heartbeat.

Let me explain. Like you and probably everyone you know, I've always been confounded by my sleep routine. Why do I one morning rise ready to tackle the day and the next seem barely able to lift my head? How much rest can I be getting if I wake up sideways with the covers on the floor and my wife in the guest room? Most important, what can I do better? I don't want a magic pill. I've tried those. I know the rules of thumb: less stress, more exercise, better diet, no afternoon caffeine, put down the damn phone. But I'd kill for a personalized formula.

So I subjected myself to a polysomnography test, or PSG, hoping to unravel some of the mysteries of the night. My procedure was administered in the offices of Fullpower Technologies, one floor down from where I had spent most of the evening talking with the company's founder and CEO, Philippe Kahn.

A French expatriate who grew up in Paris, Kahn, 63, is a Silicon Valley oracle whose track record predates the web. He founded Borland Software (acquired by Micro Focus) in the mid-1980s, followed by Starfish software (Motorola) and LightSurf Technologies (VeriSign). In 1997, while anticipating the birth of his daughter, he paired a state-of-the-art Casio camera with a Motorola Startac and became, he claims, the first person to transmit a digital photo over cellular airwaves. He's also been a leader in wearable technologies.

That's precisely the focus of Fullpower, which licenses its software to other companies. Nearly five dozen framed patents for wearable-related software and devices hang on the wall in the company's lobby. The oldest dates to 2005, long before tracking steps became such a phenomenon. In the conference room there's an assembly of chairs and tables around a full-size bed, making obvious Kahn's latest obsession.

Fullpower built the lab about a decade ago to capture data from sleep patterns. Of course,

test subjects don't typically snooze deeply with wires glued to their skulls, chests, legs, and arms. But almost everyone manages to at least nod off for a while, and the data that subjects generate are valuable and often surprising. "What we found early on is that sometimes you sleep less and feel more refreshed," Kahn says. "It's because you woke up in the light part of the sleep cycle." The insight led him to develop a sleep-cycle alarm that could determine the best time to alert a person within a certain window. "Sometimes it's better to get up at 10 of seven than at seven," he says.

Kahn insists that he's on the cusp of many more such discoveries, and he's intent on dispelling some of the conventional wisdom that stresses people out. "People say that if you can't sleep for eight hours without waking up, something's wrong with you. That's such a fallacy," he says. "Before electricity, people used to sleep in two shifts. That's how I behave. Sleep for four hours, get up and do an hour and a half of work, and then another four." He's also skeptical of the notion that a quiet room is the best environment for shut-eye and dismisses the perceived deleterious effects of repeated rousing. "The sign of good sleep hygiene may not be how many times you wake up, but rather how rapidly you fall back to sleep. Sleep should be like hunger. Eat only when you're hungry and until you're satisfied."

Fullpower has oceans of data to back Kahn's theories. The company provides the sleep-tracking and activity-monitoring software for the Jawbone UP and Nike Fuel wearable devices as well as a new line of Swiss-made smartwatches and the forthcoming Simmons Sleeptracker Smartbed. The products transmit a mother lode of information (with users' consent) to Kahn's team. He thinks that by combining qualitative lab data and quantitative real-world data with machine learning, artificial intelligence, and other analytics technologies, he can unlock the secrets that so many of us walking dead are looking for: a better night's sleep. "We're operating a huge sleep experiment, worldwide, unlike anything anyone has ever done," he says. "We have 250 million nights of sleep in our database, and we're using all the latest technologies to make sense of it."

Kahn is not alone. He's part of a movement of brilliant entrepreneurs, data scientists, engineers, and academics who are looking at demographics, geographies, and lifestyles, and even into our genomes. They're the beneficiaries of a historic explosion in sleep data, and they're using many of the same technologies that are busily decoding some of the world's other great mysteries. Tiny sensors, big data, analytics, and cloud computing can predict machine breakage, pinpoint power outages, and build better supply chains.

Why not put them to work to optimize the most valuable complex system of all, the human body?

It's not an exaggeration to say lack of sleep is killing us. The Centers for Disease Control and Prevention calls it a public health epidemic and estimates that as many as 70 million Americans have a sleep disorder. Sleep deprivation has been linked to clinical depression, obesity, Type 2 diabetes, and cancer. The National Highway Traffic Safety Administration estimates that drowsy driving causes 1,550 deaths and 40,000 injuries annually in the U.S. There are 84 sleep disorders, and some 100 million people—80% of them undiagnosed—suffer from one of them in particular: Obstructive sleep apnea, generally indicated by snoring, costs the U.S. economy as much as $165 billion a year, according to a Harvard Medical School study. That's more than asthma, heart failure, stroke, hypertension, or drunk driving. And the study doesn't account for tangential effects, like loss of intimacy and divorce. BCC Research predicts that the global market for sleep-aid products—everything from specialty mattresses and high-tech pillows to drugs and at-home tests—will hit $76.7 billion by 2019.

The financial upside for anyone who can crack the sleep code is obvious. And so the race is on. "I believe that 15 years from now, if we do this right, we can actually tackle epidemics like obesity, diabetes, and high blood pressure, and any number of lifestyle diseases," says Kahn. "We're going to help people live longer and better lives."

IN 1934 THIS MAGAZINE RAN a sprawling cover story under the simple headline "Sleep." Published about three decades after the dawn of sleep research, it explored a litany of the day's devices, concoctions, drugs, and homespun remedies designed, or at least purported, to help insomniacs. The article chronicled the merits of everything from Ovaltine to morphine and Barbital, a synthetic hypnotic that was used as a sleep aid until the mid-1950s despite being habit-forming and occasionally deadly. The story also unpacked the relationship between Zalmon G. Simmons and Harry M. Johnson. Simmons was the president of the eponymous company his father founded, which has by now sold nearly 100 million mattresses, most notably under the Beautyrest brand. Johnson was a psychology professor at Ohio State who was conducting sleep research on the side.

At the time, old Zalmon was looking to solve two problems: He needed to sell more mattresses. And he needed sleep. The head of the iconic mattress maker was an insomniac! So he gave Johnson $25,000 to set up a sleep lab at the university now known as Carnegie Mellon. At the time it was believed that normal sleepers lay motionless throughout the night. Johnson collected 2.5 million data points from 160 subjects and demonstrated the folly of that theory. Normal sleepers, he determined, change positions from 20 to 85 times a night, with 35 being a sort of sweet spot. When we toss and turn more, we wake up groggy; any less, and we're stiff and sore. (The insight would pay dividends for Simmons, the company. Spurred by the revelation that proper sleep required movement, it became the first to introduce king- and queen-size mattresses. Unfortunately, Zalmon didn't solve his personal problem. His insomnia devolved into depression and, in the words of the article, his "fortune began to wobble. Soon after that, sleep ceased to be a problem. For Zalmon G. Simmons was dead.")

Those movements are what enable today's wearable devices to monitor sleep. Gartner Group projects sales of 36 million smart wristbands, a category that includes most Fitbit devices, Jawbone UP, and Nike Fuel, in 2015 and 2016. Fitbit is definitely king. NPD Group estimates that it has an 85% market share. Fitbit raised $732 million in a highly anticipated IPO stoked by the impressive metrics revealed in its S-1 filing: nearly $132 million in net income on $745 million in revenue last year, with $336 million in revenue in the first quarter of this year. Fitbit has sold more than 21 million devices since 2008 and has 9.5 million active users.

That means Fitbit is gathering far more data in one night than Johnson did in his career. Thanks to its sleep-monitoring technology, the

RETHINKING THE RULES OF REST
Much advice for good slumber is accepted: Establish a regular bedtime, don't work (or read email) in bed, exercise, eat right, and lay off alcohol before you turn in. But researchers such as Kahn are challenging hoary wisdom. Their points are crucial because the stress we feel about sleep is often the biggest impediment to it:

1. EIGHT NEEDN'T BE STRAIGHT
Eight hours of solid sleep can be wonderful, but through most of human history, people slept for four hours, woke for an hour or two, then went back to bed for another four.

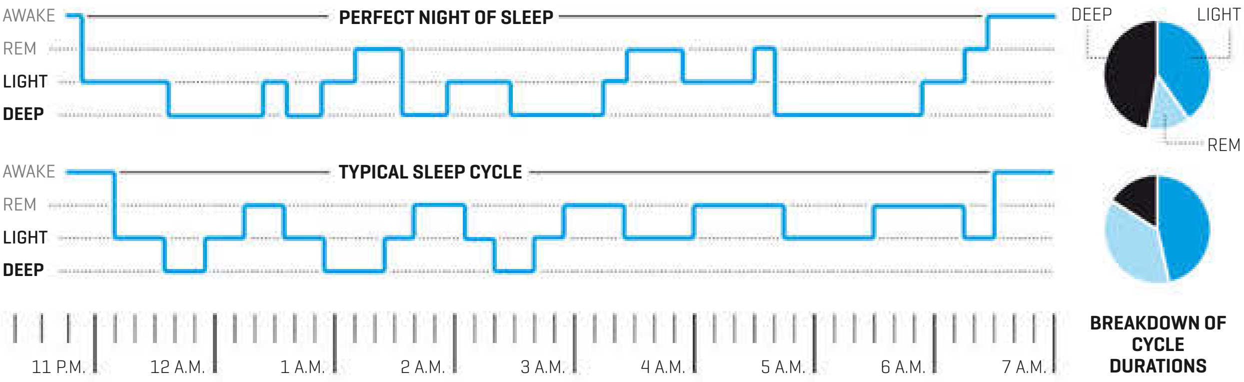
2. PARDON THE INTERRUPTIONS
People wake up an average of 9.3 times a night, so don't fret if you stir repeatedly. Kahn argues the ability to fall back asleep is the key sign of sleep health.

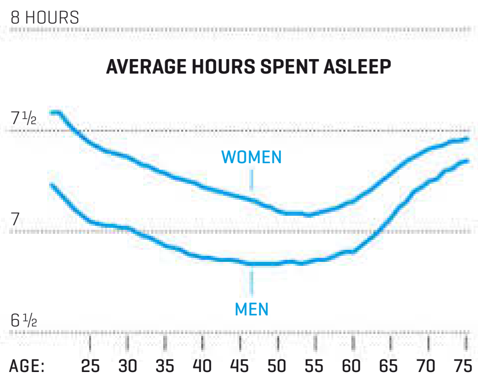
3. THE CYCLE MATTERS
Sometimes, Kahn says, people feel more refreshed with slightly less sleep, if they wake up at the right point in their cycle. (He designed an alarm clock for this purpose.)

4. HEED YOUR CHRONOTYPE
Are you a morning person or a night owl? Organize your activities to comport with your most comfortable state.

Restless Nights

THE SLEEP CYCLE of the average person, according to Fullpower Technologies' data, diverges from an ideal cycle (below). A key difference is the amount of deep sleep, the most restful state (right).





Fitbit's sleep data show that women average about 20 minutes more sleep per night than men until age 45, at which point the gap narrows.

company can distinguish among variations in movements and has determined that the majority of its users actually wake up between three and 17 times a night—9.3 times being average. Most awakenings are short and probably not remembered. Fitbit's data suggest that the number of awakenings drops with age until about 45, and then remains flat. Men under 50 have, on average, one more awakening per night than women of the same age, but the discrepancy largely disappears after 50.

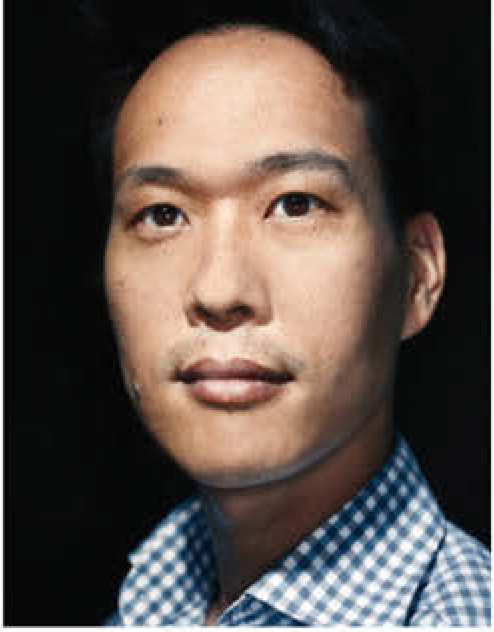
Fitbit's research team developed the algorithms to gather and analyze all these data under the guidance of Shelten Yuen. Yuen, 36, who has a Ph.D. in engineering sciences, has worked in missile defense and has done research in surgical robotics. He was approached by Fitbit's co-founders back in 2010 to write the software underlying the wearable device they were envisioning. "Crazy sensor thing?" Yuen remembers thinking. "That's my deal." He signed on as employee No. 4.

The first goal for Fitbit was tracking steps. Yuen figured it would be a snap—until he realized that a regular accelerometer can't distinguish between a wrist that's moving with a walking gait and a wrist that's, say, shoveling food. He delivered what he thought was the perfect device. "They said, 'Did you try scratching your head? Did you put it in your pocket? How about strapped to a bra?' Suddenly it became a crazy, phenomenally hard problem," he remembers.

Steps are easy compared with sleep. For starters, what's the difference between an absence of movement while trying to sleep and actual sleep? Wearables are beginning to incorporate heart-rate monitoring, which helps correlate sleep stages, but they don't measure respiration or neural activity like a polysomnograph and so rely more heavily on inference.

Fitbit encounters skepticism from users, including me, about the accuracy of its sleep measurement. Yuen admits he hasn't achieved perfection, but he largely brushes off the incredulity, saying it stems from the fact that our instincts for how well we're sleeping don't typically match reality. For steps, users can monitor their progress, but not so with sleep. (For his part, Kahn insists that he has the formula for maximum accuracy: He says his huge quantity of rock-solid polysomnography data and wristband sleep-tracking information have helped him develop an algorithm that adjusts for the imperfections of wristband data.)

Whatever the accuracy of Fitbit's data, the company has a ton of it, and is seeing some interesting patterns. Yuen calls one of his data scientists, Jacob Arnold, 31, into the conference room at Fitbit headquarters in San Francisco's South of Market neighborhood. Arnold also has a Ph.D., his in astronomy and astrophysics. Together they unveil some graphs demonstrating that people around the world get more sleep in winter and less in summer. Daylight



"We need to take the veil off of sleep," says Shelten Yuen, who leads Fitbit's research team and wrote the original software that tracks Fitbit users' movement and sleep.

clearly has an effect on sleep patterns; temperature might too. We sleep less on the hottest day of the year than on the longest day. The data show that the longest average duration of sleep usually occurs on the weekend following New Year's Day. Yuen also makes it clear that getting a lot of sleep is not equivalent to having a restful night.

Yuen and Arnold then reveal a graph demonstrating that, statistically speaking, no one gets less sleep than the demographic group to which I belong, fortysomething males. I'm not sure how to take the news. Is it a body blow or a hopeful sign of more rest in my future?

Establishing the norm the way these charts do is an important step from a scientific standpoint. But to be indispensable in the marketplace, Fitbit needs to empower users with real guidance. "We need to take the veil off of sleep," says Yuen. "We need to make this data much more understandable so they don't feel powerless."

Fitbit co-founder and CEO James Park echoes the sentiment. Some analysts are predicting that fitness trackers have peaked, especially because of the launch of the Apple Watch (which doesn't track slumber because it needs to be charged every night). Park knows that if he can help his customers sleep better, Fitbit will become irreplaceable. "A lot of clinical studies show that certain behaviors might affect sleep: light levels, noise levels, caffeine, time of exercise," says Park. "The next step is to tie prescriptive elements into it. That's one of the big opportunities for this category. Can companies actually deliver coaching services to help people sleep that consumers actually want to pay for?"

NOT LONG AFTER MEETING Steve Kay, dean of the Dornsife school of arts and sciences at the University of Southern California, I notice he's wearing a Fitbit. Curious about what kind of a sleeper one of the world's leading experts in circadian rhythm would be, I ask how he'd fared the night before. He looks at the app on his phone. "I went to bed at a quarter past 11 and got up at 20 past four," he says with a shake of the head. Count Kay among the many of us getting less rest than we need.

I'm in Kay's conference room with Ross Bersot, a venture partner at Bay City Capital turned entrepreneur. Bersot, 40, and Kay, 53, are a latter-day Zalmon Simmons and Harry Johnson. A few years ago, Kay published research demonstrating that it's possible to isolate and manipulate the speed of an organism's circadian rhythm using molecular compounds. Bersot provided funding to Kay's lab in hopes of potentially starting a company based on more detailed findings. That company, Reset Therapeutics, is now real and based in the Bay Area.

Like Fullpower and Fitbit, Reset is intent on getting to the heart of the nature of sleep. But while others duke it out for wrist real estate, Reset is going deep into our bodies with a different set of tools. It's pairing Kay's research with the latest advances in genomics and high-throughput screening, and partnering with personal-genetics startup 23andMe to try to develop a drug that can manipulate our circadian rhythm.

Almost every living thing on earth has an internal clock—or more accurately, a symphony of clocks ticking away at the cellular level—that tells its owner when to rest and when to produce. It's not just humans. Monsanto recently published a paper demonstrating that it could boost soybean yields 5% by tweaking one of the plant's clock-associated genes. "We're trying to help them figure out why," says Kay, whose lab is working with Monsanto. "And all the major ag and biotech companies are interested. When you're a plant stuck in the ground, everything is circadian. Biomass, yield, response to extreme temperatures—it's all clock regulated."

Human clocks are equally powerful, but we aren't quite as enslaved by them because we don't depend on photosynthesis. By some estimates, up to 70% of us live in spite of our internal clocks, or in the scientific jargon, outside our chronotype. Your chronotype predisposes you to being a night owl or a morning person or even being hungry at certain times, and many of us are guilty of ignoring our chronotypes, whether because of our lifestyle or just the call of duty.

When we live largely out of sync with our chronotypes, we experience everything from grogginess and reduced productivity to digestion issues, weight gain, and accelerated aging. We also increase our risk of obesity and Type 2 diabetes. Kay cites studies that link such lifestyles to an

increased rate of breast cancer. “We evolved to adapt on this planet that has periods of light and dark. But modern life is really clashing with that,” he says. “The key is being internally synchronized. Your sleep-wake cycles, your food-intake cycles, your metabolic cycles are all working together. When they’re out of sync, that’s when (a) you feel lousy, and (b) you start seeing the disturbance of all kinds of markers. Sleep efficiency collapses. Leptin plummets. Insulin goes up.”

Reset wants to tweak our clocks with a drug. Such a drug would help reset the chronotypes of people who choose or need to live a different lifestyle or whose clocks are impaired. For now the development phase is limited to two so-called orphan diseases, narcolepsy—a neurological disorder that causes significant daytime sleepiness and in some cases cataplectic attacks—and Cushing’s disease, a neuroendocrine disorder characterized by excess blood sugar, obesity, and pituitary tumors.

Working with orphan diseases enables the company to help people sooner and get on the fast track to regulatory approval. “With the Cushing’s program, we’re focused on a protein that makes a clock run at a 24-hour cycle,” says Bersot. And so far, so good: “We’re restoring the rhythms to a 24-hour period, and in our early work with animals, we’ve seen blood glucose and insulin levels return to normal as a result.” Reset plans to take the Cushing’s drug to clinical trials next year and the narcolepsy treatment after that. Bersot hopes that once the drug establishes its ability to reset the body clock for sufferers of those diseases, Reset will develop it more broadly as a sleep aid for shift workers and anyone else whose clock and lifestyle are misaligned.

In the meantime the company is working with 23andMe to explore correlations between chronotypes and various genetic expressions. According to Emily Drabant Conley, 23andMe’s director of business development and a Ph.D. in neuroscience, 80% of 23andMe’s customers allow their genotypes to be used in research. She’s scouring their files in hopes of finding correlations between genotypes and sleep-related survey data. For example, how do people of a given genetic expression most commonly answer these questions: How many hours of sleep do you average? Do you snore? Do you take sleep medication? “Sleep is interesting because it’s not like eye color, where you have only five choices. Having a lot of data that you can mine is important,” she says. “But we’re just at the beginning. We’ve done the first pass at the genetics of being a morning person. We know that genetics plays a role in whether you need six hours or eight hours. The prescriptive aspect will come.”

IT’S A COMMON REFRAIN, and despite the way it may sound to someone yearning for rest, it’s hardly a cop-out. In the realm of data science there’s a commonly accepted notion of how progress occurs. First comes descriptive analytics, next predictive analytics, and finally prescriptive analytics. In other words, describe the system, predict outcomes based on those descriptions, and prescribe actions to attain desired outcomes.

To the layperson, prescription may sound like the most difficult phase, but in reality the hardest part is often where we are today, measuring and mapping behavior just to get to the point where it's conceivable to predict behavior and prescribe actions.

Science is clearly advancing in the quest to understand sleep. We're adding data in quantities that were unimaginable even a decade ago, much less during the time that *Fortune* first considered the subject. Big Pharma and biotech companies are drilling into our genomes to find links between DNA and nighttime routines; they're also exploring medications that adjust the circadian rhythm.

Wearable-device companies are casting nets far and wide. Fitbit recently enabled its devices to track sleep automatically, rather than as a user-triggered behavior, and some of its devices now monitor heart rate, which helps Yuen and Arnold make finer distinctions between lack of motion and restful sleep. Fullpower just entered a partnership with Simmons to provide sleep-tracking technology for the mattress maker's new Sleeptracker Smartbed, which will provide noninvasive sleep-monitoring technology and is scheduled to hit the market in 2016.

On top of all this, scientists around the world are using cheap wearables to conduct their own exploratory research. A quick search of Google Scholar shows dozens of wearable-powered experiments and papers detailing the efforts to unravel the mysteries of the night. All of which will—one day soon, let's hope—translate to a more personalized analysis and formula for how each of us can get a better night's sleep.

Which brings me back to my night in Fullpower's sleep lab. A few days after my test I received a PSG report that shines a light on my own personal darkness. The prognosis was mixed. The good news: My sleep-efficiency score was a robust 93.5%—"You should be proud of that," says Kahn—which means that most of the time I'm in bed, I'm sleeping. And I'm quick. I drifted off in 2.5 minutes, even with all those wires attached. The bad: I snored. In fact, I was diagnosed with "mild to moderate" apnea. That officially makes me part of the $165 billion problem. I was advised to see a doctor.

That's not the prescription I was looking for. I'm not crazy about doctors, and I'm afraid of being persuaded to buy a machine that I won't use. So for now, I think I'll just keep trying to do what I know to be right. Exercise. Keep a consistent routine. Restrict the hours that I eat, try to lay off the junk food and booze, and hope that before long someone will offer me a more personalized regimen.

Until then, I'll always have the memory of a laughing, volleying Marissa Mayer and the knowledge that together, on one strange night in Santa Cruz, we—and whatever caused my 17 other REM interruptions—slept, or at least tried to, in the name of progress.

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WHILE YOU WERE OUT

Thriving in the Age of Fraudulence

Cheaters never win? *Au contraire.* Crossing the line is clearly the best way to get ahead. And more fun too. ***By Stanley Bing***

I'VE BEEN GIVING a lot of thought to whether I should become a lying, cheating, duplicitous SOB. There is ample evidence that it's a very respectable strategy in whatever field you put your mind to—sports, entertainment, the arts, and, of course, business. The world we live in is flooded with no-goodniks who, to my eye, seem to be doing very, very well. Sure, like any worthwhile strategy, being a sleazebag has its dangers. But both history and the front page of your daily news destination will testify that the approach has to be considered, particularly by young aspirationals before they become too set in their ways. Let's look at the pros and cons.

Pro: *It's profitable.* Examples abound, but you only have to look at the alleged miscreants at FIFA who were recently arrested for massive defalcations. The Feds charge that one bribe alone, from soccer entities in South Africa to a FIFA official who controlled most of the Western Hemisphere, amounted to $10 million. Ten million dollars! Just one bribe! You and I have to work years to make that kind of money honestly.

Pro: *It's diverting.* Hedonists everywhere breathed a sigh of relief when French sybarite and presidential aspirant Dominique Strauss-Kahn was recently acquitted of being a pimp who recruited hookers for orgies attended by his wealthy friends and associates. No uptight middle-management type is he. And don't even get me started on Mr. Berlusconi. Bunga bunga! And still in business!

Pro: *You can be better.* Run faster. Jump higher. Achieve the kind of edge that gave crafty inside traders from Ivan to Martha to Raj a leg up to pull off the kind of deals you and I only dream of. And they're just the ones who got caught. Consider the mouthful of canary now being enjoyed by the cats who weren't. And aren't.

Pro: *You will be feared.* The corporate world will tremble and governments will cower while we all repeatedly change our passwords in a vain attempt to stave off the inevitable.

Pro: *You will be admired.* You can be a highly regarded, massively wealthy pundit who advises the SEC while you're fleecing old people of their retirement checks. Then you can be a highly regarded criminal helping your prison buddies do their taxes. People love a winner, especially their winner, no matter how, um, deflated others may feel when they find out about you.

Pro: *You can get what you want even when you don't deserve to.* No, it's not obvious what right Russia has to invade Eastern European neighbors like Latvia, Estonia, and Ukraine. That doesn't mean the talented Mr. Putin isn't going to try. Because rules? Feh!

Pro: *You can maintain your self-respect.* Lance Armstrong makes the excellent point that for many years everybody has been flooding their bodies with illegal substances to get the job done. He was just better at not getting caught. The same rationale was employed by a generation of baseball players and a decade's worth of bankers who did really lousy things to people and felt totally awesome about themselves while they were at it. They're probably at it again, come to think of it. Ah well, we'll find out about that soon, I'm sure.

Pro: *The risks are manageable.* You can throw your associates under the bus before you go down. And even if the worst happens, you often walk out of the country club with a comfortable chunk of your gains intact. How many former felons are now respected philanthropists driving around in their Bentleys and lighting cigars with $100 bills? A lot, believe me.

Con: *It would be wrong, and people might get hurt.* Hmm. Yeah. There's that.

Take a minute. Think about it. And if the final consideration concerns you, raise your hand. It's possible you should move to the back of the class.

Follow Stanley Bing at stanleybing.com and on Twitter at @thebingblog.

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